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THE GIFT CODE USER MANUAL; VOLUME II, THE OUTPUT OPTIONS

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September 1979

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Geometric Information for Targets (GIFT) code is a FORTRAN languaged code used to mathematically describe the geometry of a three-dimensional vehicle such as a tank, truck or helicopter. The geometric data generated by the GIFT code is merged in vulnerability computer codes with the energy effects data of a selected munition to simulate the probabilities of malfunction or destruction of components when it is attacked by the selected munition.

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To simulate the geometry of a vehicle, the GIFT code uses combinatorial geometry (COM-GEOM) data. The COM-GEOM data consists of three tables: a Solid Table, a Region Table, and a Region Identification Table. The GIFT code contains numerous tests and checks to ensure that COM-GEOM data listed in these three tables is correct.

The GIFT code options include those which graphically display the vehicle, those which check the correctness of the geometry data, those which compute physical characteristics of the vehicle, and those which generate the geometric data used by vulnerability codes.

This report is a User Manual which describes the tests made on the COM-GEOM data, the output options and the output generated by the GIFT code.

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I. INTRODUCTION

This report is a user's manual describing the output options and the output of the Geometric Information For Targets (GIFT)[1] computer code. The GIFT code mathematically simulates the geometry of a three-dimensional physical entity such as a tank, truck, helicopter, etc., for the computer. The bulk of the data used by the GIFT code is called combinatorial geometry (COM-GEOM) target description data. These data have been described in the Ballistic Research Laboratory Report No. 1802 and will not be discussed in this report. Reading Report 1802 prior to this one is suggested for those not familiar with COM-GEOM data.

Computer target simulation codes such as GIFT can compute the physical properties of a prototype (concept) or a foreign vehicle before the physical vehicle is available for empirical measurements. These codes can compute many of the properties of a target with less cost and time than they can be measured via empirical test procedures. For these reasons, the Air Target Vulnerability Subgroup of the Joint (Army, Navy, Air Force) Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) evaluated, selected and sponsored the detailed documentation of the MAGIC[2] and SHOTGEN[3] computer codes. These two codes use different techniques to prepare target description data, but they both supply the angular and spacial coordinates of the target which are used as input by the "vulnerability analysis" computer codes. The techniques employed within these and other codes, plus the comments and suggestions received and the needs of potential users, influenced the development of the GIFT code.

There are various output options of the GIFT code, each of which may be subdivided into groups of subroutines. Each output option consists of one or more subroutines which perform one general function. The output options generally are under one of the following three categories when classed by the general function they perform: those options called CHECK and TESTG that check the COM-GEOM description for correctness and accuracy; those options called PICTUR, XSECT and PLTRPP that produce visual representations of the COM-GEOM description; and

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1. *Lawrence W. Bain, Jr. and Mathew J. Reisinger, "The GIFT Code User Manual, VOL I, Introduction and Input Requirements," Ballistic Research Laboratory Report No. 1802, Jul 1975, AD#B06037L.*

2. *NWC TN 4565-3-71; VOLS I and II, "MAGIC Computer Simulation, VOL I, User Manual; VOL II, Analyst Manual," Armament Systems, Inc., and Propulsion Development Department, May 1971 (available from Department of the Navy, Naval Weapons Center, China Lake, CA 93555).*

3. *NWC TN #4565-3-70, VOLS I and II: "SHOT GENERATOR Computer Program VOL I, User Manual: VOL II, Analyst Manual," Armament Systems, Inc., and Propulsion Development Department, July 1970 (available from Department of the Navy, Naval Weapons Center, China Lake, CA 93555).*

those options called GRID, RIP, MOMENT, VOLUME and AREA that produce data used in vulnerability analysis.

II. DISCUSSION

A. Card Deck Set-Up

The input data of the GIFT code normally consists of a Control card, the COM-GEOM description data (which consist of a Title card, a Target Specification card, Solid Table cards, Region Table cards, Region RPP Table cards (optional), and Region Identification Table cards), a Declaration card stating the output option desired; and a set of input cards for the declared option. The cards containing the Declaration card and the set of input cards for the declared option can be repeated for as many output options as desired. Figure 1 depicts the order of the card input for the GIFT code. The general structure of the input data of the GIFT code is not expected to change. However, new options are periodically added to the GIFT code which may require changes to the input data. The input defined in this report exemplifies the input needed for the GIFT code as of 1 October 1978.

B. Control Card

The Control card, depicted in Figure 2, is the first data card read by the GIFT code. It sets some of the general variables used throughout the execution of the GIFT code and options executed during the input processing of the COM-GEOM data via the GENI portion of the GIFT code. It should be noted that the Control card described in this report is different than the one described in BRL Report 1802.

When the COM-GEOM description data is read by the GENI portion of the GIFT code, it is stored in a large equivalenced array called MASTER-ASTER. If a non-zero number is in Column 2 of the Control card, the GIFT code will write this MASTER-ASTER array and some constants in binary form on FORTRAN Unit 4 after the COM-GEOM data has been processed by the GENI portion of the GIFT code. After the data is written, the following message is printed: "PROCESSED GEOMETRY WRITTEN ON TAPE 4."

In subsequent computer runs, the data written on FORTRAN Unit 4 may be used instead of the unprocessed COM-GEOM description as input for the GIFT code. A non-zero number in Column 1 of the Control card indicates that binary data on FORTRAN Unit 4 containing processed COM-GEOM description data is to be used as input. The computer run time and printing is reduced by using this option. However, the binary data on FORTRAN Unit 4 is difficult to change, and should be created only after it is reasonably certain that the COM-GEOM description does not contain any errors.

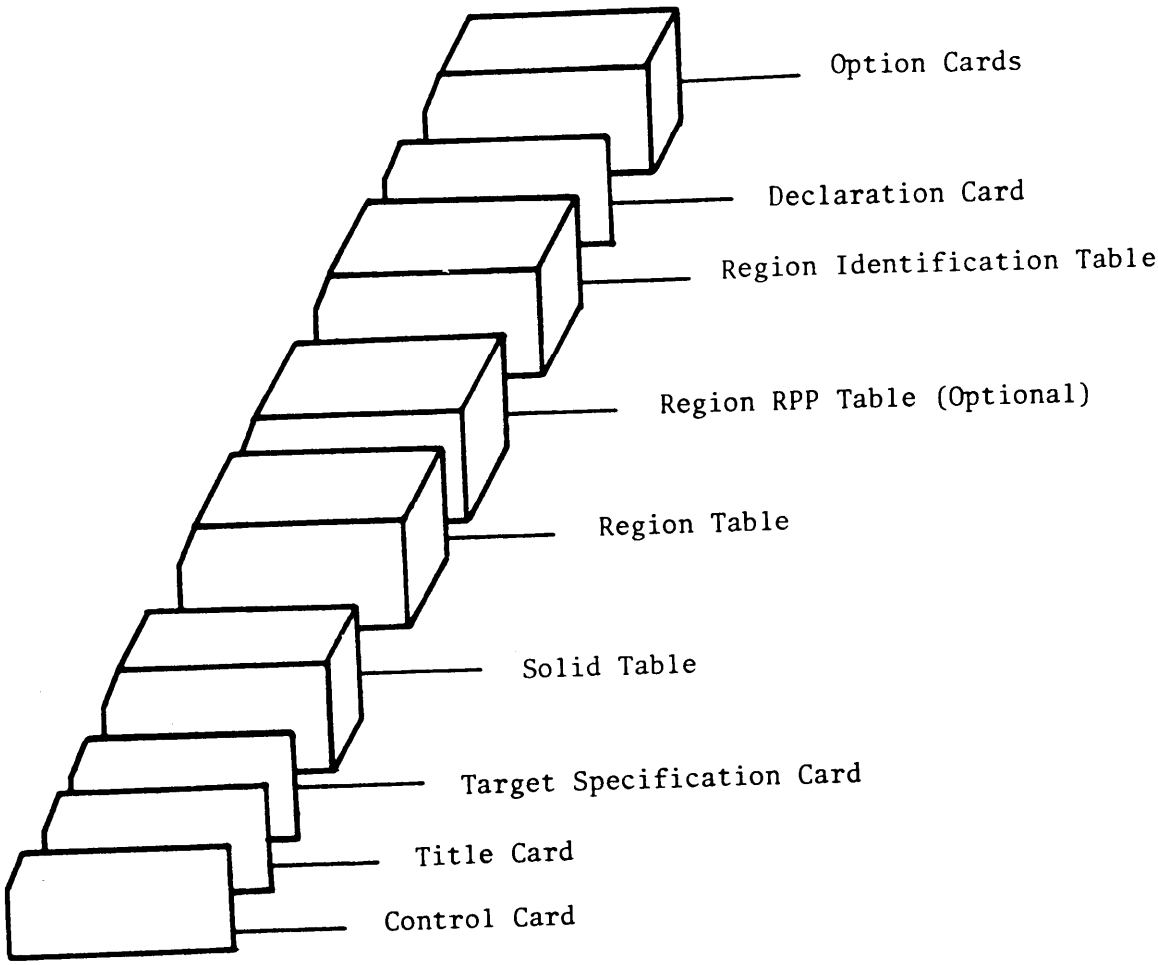


Figure 1. Order of the Card Input for the GIFT Code

1	2	3-5	6	7	8	9	10	11-30	31-40	41-50	51-55	56-60	66-80
IRDTP4	IWRTP4	IN	IPRNT	ITEMPR	IMNMX	ISOLEQ	NOPRNT		TOL	TOLLOS	IVOID	IFANTM	

IRDTP4 - If not zero, read processed geometry from FORTRAN Unit 4.

IWRTP4 - If not zero, write processed geometry on FORTRAN Unit 4.

IN - FORTRAN unit containing the COM-GEOM description (Default 5).

IPRNT - If not zero, print MASTER-ASTER arrays containing the processed COM-GEOM description.

ITEMPR - If not zero, print the Region Identification Table ordered by item code.

IMNMAX - If not zero, print an ordered Region RPP Equivalent Table.

ISOLEQ - If not zero, print the Solid RPP Equivalent Table.

NOPRNT - If not zero, do not print COM-GEOM description but only summary storage information.

TOL - Specify overlap tolerance (Default = 0.0001).

TOLLOS - Specify the minimum line-of-sight (Default = 0.0001).

IVOID - Specify the void space code (Default = 1).

IFANTM - Specify the phantom item code (Default = 111).

IEND - Specify the code to signal end of components along ray (Default = 9).

Figure 2. Control Card for GIFT Code

Columns 3-5 of the Control card specifies the FORTRAN unit number of the tape (or equivalent) containing the (COM-GEOM description data. A numeric zero or a "5" in card columns 3-5 indicates the COM-GEOM description data is to be read from FORTRAN unit 5.

If Column 6 of the Control card is not zero, the contents of the MASTER-ASTER array will be printed. This option is primarily used by a computer programmer to "debug" the GIFT code. Table II is an example of the MASTER-ASTER array printout for the COM-GEOM description of the sample target depicted in Figure 3 and listed in Table I.

If Column 7 of the Control card is not zero, a Region Identification Table ordered by Region Identification (Item) Code numbers is printed. The regions with no Item Code number are printed first, followed by those with Air Space Code numbers and then those with an Item Code number. This option is particularly useful for locating a region or regions when only an Item Code is known or locating regions with wrong Item Code numbers or without Item Code numbers. Table III is the ordered Region Identification Table for the COM-GEOM description of the Sample Target.

If Column 8 of the Control card is not zero, an ordered Region RPP (rectangular parallelepiped) Equivalent Table is printed. An RPP equivalent for a region is that smallest RPP solid which would completely enclose it. Table IV is an ordered Region RPP Equivalent Table for the COM-GEOM description of the Sample Target. Referring to Table IV, the heading "COUNT" is a series of consecutive integers starting from 1 and ending with the number of regions in the Region Table (20 for the Sample Target). The x, y, and z minimum (XMIN, YMIN, and ZMIN) coordinate values of the enclosing RPPs of the regions are odered from the largest to the smallest. The x, y, and z maximum (XMAX, YMAX and ZMAX) coordinate values are ordered from the smallest to the largest. The integers in the columns under letters A through F are the region numbers that are associated with the preceeding XMIN, XMAX, YMIN, YMAX, ZMIN, ZMAX columns. Therefore, the order of the regions from the top to the bottom of the sample target are listed in the column associated with the ZMIN coordinate values (labeled E). Likewise the order of the regions from front to back of the Sample Target are listed in the XMIN associated column (labeled A) and the order of the regions from left to right are listed in the YMIN associated column (labeled C).

If Column 9 of the Control card is not zero, a Solid RPP Equivalent Table is printed. The Solid RPP Equivalent Table displays an RPP solid which would completely enclose each solid of the COM-GEOM description. Table V is a Solid RPP Equivalent Table for the COM-GEOM description of the Sample Target. Solid 12 in Table V never appears in the Region Table preceeded by a plus (+) sign (solid 12 appears in the description of region 11 as "-12"); therefore, the Equivalent Solid RPP is not calculated.

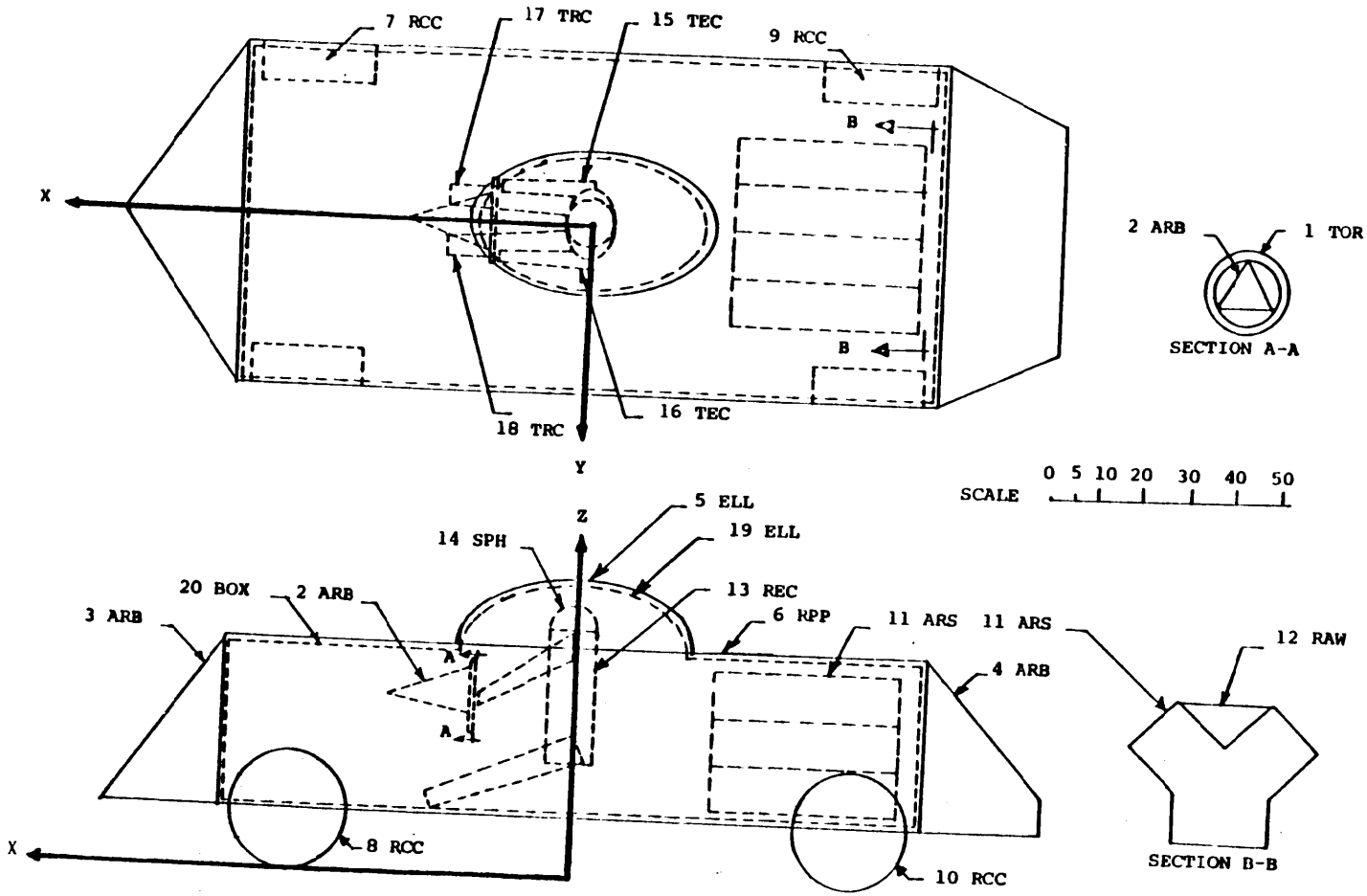


Figure 3. Engineering Drawings of the Sample Target

Table I. COM-GEOM Description of the Sample Target

```
SAMPLE INPUT FOR GIFT                                                    IN
                    20        20
1  TOR      21.5      0.      37.      1.      0.      0.    STEERING
1            8.0     1.0                                     WHEEL
2  ARB4     21.5     -6.      33.5    21.5     6.     33.5   CENTER
2           21.5      0.      44.     40.      0.     37.    STEERING
3  ARB5     75.     -36.      12.     75.     36.     12.    FRONT
3           75.      36.      48.     75.    -36.     48.      3-2
3          100.      0.       12.                             3-3
4  ARB8    -75.     -36.      12.    -75.     36.     12.    REAR
4          -75.      36.      48.    -75.    -36.     48.      4-2
4         -100.     -24.      12.   -100.     24.     12.      4-3
4         -100.      24.      20.   -100.    -24.     20.      4-4
5  ELL      20.      0.       48.    -20.     0.      48.    BUBBLE
5           50.
6  RPP     -75.      75.     -36.     36.     12.     48.    BODY
7  RCC      60.     -36.      12.      0.      8.      0.    WHEEL
7           12.
8  RCC      60.      36.      12.      0.     -8.      0.    WHEEL
8           12.
9  RCC     -60.     -36.      12.      0.      8.      0.    WHEEL
9           12.
10 RCC     -60.      36.      12.      0.     -8.      0.    WHEEL
10          12.
11 ARS                6        5                             ENGINE
11         -30.     -10.      15.    -30.    -10.     15.      11-2
11         -30.     -10.      15.    -30.    -10.     15.      11-3
11         -30.     -10.      15.                             11-4
11         -30.     -10.      15.    -70.    -10.     15.      11-5
11         -70.      10.      15.    -30.     10.     15.      11-6
11         -30.     -10.      15.                             11-7
11         -30.     -10.      25.    -70.    -10.     25.      11-8
11         -70.      10.      25.    -30.     10.     25.      11-9
11         -30.     -10.      25.                             11-10
11         -30.     -20.      35.    -70.    -20.     35.      11-11
11         -70.      20.      35.    -30.     20.     35.      11-12
11         -30.     -20.      35.                             11-13
11         -30.     -10.      45.    -70.    -10.     45.      11-14
11         -70.      10.      45.    -30.     10.     45.      11-15
11         -30.     -10.      45.                             11-16
11         -30.     -10.      45.    -30.    -10.     45.      11-17
11         -30.     -10.      45.    -30.    -10.     45.      11-18
11         -30.     -10.      45.                             11-19
12 RAW     -70.      0.       35.      0.    -11.     11.    (ENGINE)
12           0.      11.      11.     40.     0.      0.
13 REC       0.      0.       24.      0.     0.      28.    TRUNK
13           0.      7.5       0.      5.     0.      0.
14 SPH       0.      0.       52.      5.                     HEAD
15 TEC       0.     -7.5      49.     20.     0.     -12.    ARM
15           0.      0.        3.      0.     2.      0.      15-2
15           2.                                              15-3
16 TEC       0.      7.5      49.     20.     0.     -12.    ARM
16           0.      0.        3.      0.     2.      0.      16-2
16           2.                                              16-3
17 TRC      -2.     -4.5      27.     32.     0.     -12.    LEG
17           3.      2.
18 TRC      -2.      4.5      27.     32.     0.     -12.    LEG
18           3.      2.
19 ELL1      0.      0.       48.     24.     0.      0.    (1.0)
19          14.
20 BOX     -74.     -35.      13.    148.     0.      0.    (1.0)
20           0.      70.       0.      0.     0.     34.
```

Table I. COM-GEOM Description of the Sample Target (continued)

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
-1
```

```
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
```

```
1       -2
2
3
4
5       -6      -19
6       -20     -19     -7      -8      -9      -10
7
8
9
10
11      -12
12
13      -15     -16     -17     -18
14      -13
15
16
17
18
19
20
```

```
1         40
2       1041
3        100
4        100
5        101
6        100
7        651
8        652
9        653
10       654
11      2701
12       111
13      3031
14      3031
15      3031
16      3031
17      3031
18      3031
19
20                  2
                   02
```

```
STEERING WHEEL          1-2                     TOR
STEERING SHAFT          2                       ARB4
BODY-FRONT              3                       ARB5
BODY-REAR               4                       ARB8
BUBBLE                  5-6-19                  ELL
BODY-CENTER             6-20-19-7-8-9-10        RPP
WHEEL RIGHT FRONT       7                       RCC
WHEEL LEFT  FRONT       8                       RCC
WHEEL RIGHT REAR        9                       RCC
WHEEL LEFT  REAR        10                      RCC
ENGINE                  11-12                   ARS
DUMMY REGION            0                       RAW
MAN-TORSO               13-15-16-17-18          REC
MAN-HEAD                14-13                   SPH
MAN-ARM                 15                      TEC
MAN-ARM                 16                      TEC
MAN-LEG                 17                      TRC
MAN-LEG                 18                      TRC
INSIDE AIR (BUBBLE)                             ELL1
INSIDE AIR (BODY)       20                      BOX
```

Table II. MASTER-ASTER Array Printout for the Sample Target

```
LBODY (     1 -    20)
(      1)     21      11 $ (      2)     32       9 $ (      3)     49       9 $
(      4)     70       9 $ (      5)     95       7 $ (      6)    107       1 $
(      7)    113       4 $ (      8)    120       4 $ (      9)    127       4 $
(     10)    134       4 $ (     11)    141      12 $ (     12)    429       8 $
(     13)    441       5 $ (     14)    453       3 $ (     15)    457      10 $
(     16)    472      10 $ (     17)    487       6 $ (     18)    495       6 $
(     19)    503       7 $ (     20)    515       2 $ (

LSOLID(    21 -   529)
(     21)      21.5000 $ (     22)       0.0000 $ (     23)      37.0000 $
(     24)       1.0000 $ (     25)       0.0000 $ (     26)       0.0000 $
(     27)       8.0000 $ (     28)       1.0000 $ (     29)       0.0000 $
(     30)       0.0000 $ (     31)       0.0000 $ (     32)       4.0000 $
(     33)       1.0000 $ (     34)       0.0000 $ (     35)       0.0000 $
(     36)      21.5000 $ (     37)      -.1859 $ (     38)       0.0000 $
(     39)       .9826 $ (     40)      28.9194 $ (     41)      -.1845 $
(     42)      -.8533 $ (     43)      -.4876 $ (     44)     -25.4222 $
(     45)      -.1845 $ (     46)       .8533 $ (     47)      -.4876 $
(     48)     -25.4222 $ (     49)       5.0000 $ (     50)       1.0000 $
(     51)       0.0000 $ (     52)       0.0000 $ (     53)      75.0000 $
(     54)       0.0000 $ (     55)       0.0000 $ (     56)       1.0000 $
(     57)      12.0000 $ (     58)      -.8214 $ (     59)      -.5704 $
(     60)       0.0000 $ (     61)     -82.1370 $ (     62)      -.8214 $
(     63)       0.0000 $ (     64)      -.5704 $ (     65)     -88.9817 $
(     66)      -.8214 $ (     67)       .5704 $ (     68)       0.0000 $
(     69)     -82.1370 $ (     70)       6.0000 $ (     71)      -1.0000 $
(     72)       0.0000 $ (     73)       0.0000 $ (     74)      75.0000 $
(     75)       1.0000 $ (     76)       0.0000 $ (     77)       0.0000 $
(     78)    -100.0000 $ (     79)       .4327 $ (     80)       .9015 $
(     81)       0.0000 $ (     82)     -64.9097 $ (     83)       .4327 $
(     84)      -.9015 $ (     85)       0.0000 $ (     86)     -64.9097 $
(     87)       0.0000 $ (     88)       0.0000 $ (     89)       1.0000 $
(     90)      12.0000 $ (     91)       .7459 $ (     92)       0.0000 $
(     93)      -.6660 $ (     94)     -87.9141 $ (     95)       0.0000 $
(     96)       0.0000 $ (     97)      48.0000 $ (     98)       .0400 $
(     99)       0.0000 $ (    100)       0.0000 $ (    101)       0.0000 $
(    102)       .0471 $ (    103)      -.0471 $ (    104)       0.0000 $
(    105)       .0471 $ (    106)       .0471 $ (    107)     -75.0000 $
(    108)      75.0000 $ (    109)     -36.0000 $ (    110)      36.0000 $
(    111)      12.0000 $ (    112)      48.0000 $ (    113)      60.0000 $
(    114)     -36.0000 $ (    115)      12.0000 $ (    116)       0.0000 $
(    117)       8.0000 $ (    118)       0.0000 $ (    119)      12.0000 $
(    120)      60.0000 $ (    121)      36.0000 $ (    122)      12.0000 $
(    123)       0.0000 $ (    124)      -8.0000 $ (    125)       0.0000 $
(    126)      12.0000 $ (    127)     -60.0000 $ (    128)     -36.0000 $
(    129)      12.0000 $ (    130)       0.0000 $ (    131)       8.0000 $
(    132)       0.0000 $ (    133)      12.0000 $ (    134)     -60.0000 $
(    135)      36.0000 $ (    136)      12.0000 $ (    137)       0.0000 $
(    138)      -8.0000 $ (    139)       0.0000 $ (    140)      12.0000 $
(    141)     -70.0000 $ (    142)     -30.0000 $ (    143)     -20.0000 $
(    144)      20.0000 $ (    145)      15.0000 $ (    146)      45.0000 $
(    147)      50.0000 $ (    148)       0.0000 $ (    149)       0.0000 $
(    150)       0.0000 $ (    151)       0.0000 $ (    152)       0.0000 $
(    153)       0.0000 $ (    154)       0.0000 $ (    155)       0.0000 $
(    156)       0.0000 $ (    157)       0.0000 $ (    158)       0.0000 $
(    159)       0.0000 $ (    160)       0.0000 $ (    161)       0.0000 $
(    162)       0.0000 $ (    163)       0.0000 $ (    164)       0.0000 $
(    165)       0.0000 $ (    166)       0.0000 $ (    167)       0.0000 $
(    168)       0.0000 $ (    169)       0.0000 $ (    170)       0.0000 $
(    171)       0.0000 $ (    172)       0.0000 $ (    173)       0.0000 $
(    174)       0.0000 $ (    175)       0.0000 $ (    176)       0.0000 $
```

Table II. MASTER-ASTER Array Printout for the Sample Target (continued)

(177)	0.0000	$	(178)	0.0000	$	(179)	0.0000	$
(180)	0.0000	$	(181)	0.0000	$	(182)	0.0000	$
(183)	0.0000	$	(184)	0.0000	$	(185)	0.0000	$
(186)	0.0000	$	(187)	0.0000	$	(188)	0.0000	$
(189)	0.0000	$	(190)	0.0000	$	(191)	0.0000	$
(192)	0.0000	$	(193)	0.0000	$	(194)	0.0000	$
(195)	0.0000	$	(196)	0.0000	$	(197)	0.0000	$
(198)	0.0000	$	(199)	0.0000	$	(200)	0.0000	$
(201)	0.0000	$	(202)	0.0000	$	(203)	0.0000	$
(204)	0.0000	$	(205)	0.0000	$	(206)	0.0000	$
(207)	0.0000	$	(208)	0.0000	$	(209)	0.0000	$
(210)	0.0000	$	(211)	0.0000	$	(212)	0.0000	$
(213)	0.0000	$	(214)	0.0000	$	(215)	0.0000	$
(216)	0.0000	$	(217)	0.0000	$	(218)	0.0000	$
(219)	0.0000	$	(220)	0.0000	$	(221)	0.0000	$
(222)	0.0000	$	(223)	0.0000	$	(224)	0.0000	$
(225)	0.0000	$	(226)	0.0000	$	(227)	0.0000	$
(228)	0.0000	$	(229)	-30.0000	$	(230)	-10.0000	$
(231)	15.0000	$	(232)	-1.0000	$	(233)	-30.0000	$
(234)	-10.0000	$	(235)	15.0000	$	(236)	-1.0000	$
(237)	-30.0000	$	(238)	-10.0000	$	(239)	15.0000	$
(240)	-1.0000	$	(241)	-70.0000	$	(242)	-10.0000	$
(243)	15.0000	$	(244)	0.0000	$	(245)	-30.0000	$
(246)	-10.0000	$	(247)	15.0000	$	(248)	-1.0000	$
(249)	-70.0000	$	(250)	10.0000	$	(251)	15.0000	$
(252)	0.0000	$	(253)	-30.0000	$	(254)	-10.0000	$
(255)	15.0000	$	(256)	-1.0000	$	(257)	-30.0000	$
(258)	10.0000	$	(259)	15.0000	$	(260)	-1.0000	$
(261)	-30.0000	$	(262)	-10.0000	$	(263)	15.0000	$
(264)	-1.0000	$	(265)	-30.0000	$	(266)	-10.0000	$
(267)	15.0000	$	(268)	-1.0000	$	(269)	-30.0000	$
(270)	-10.0000	$	(271)	15.0000	$	(272)	1.0000	$
(273)	-30.0000	$	(274)	-10.0000	$	(275)	25.0000	$
(276)	0.0000	$	(277)	-70.0000	$	(278)	-10.0000	$
(279)	15.0000	$	(280)	1.0000	$	(281)	-70.0000	$
(282)	-10.0000	$	(283)	25.0000	$	(284)	0.0000	$
(285)	-70.0000	$	(286)	10.0000	$	(287)	15.0000	$
(288)	1.0000	$	(289)	-70.0000	$	(290)	10.0000	$
(291)	25.0000	$	(292)	0.0000	$	(293)	-30.0000	$
(294)	10.0000	$	(295)	15.0000	$	(296)	1.0000	$
(297)	-30.0000	$	(298)	10.0000	$	(299)	25.0000	$
(300)	0.0000	$	(301)	-30.0000	$	(302)	-10.0000	$
(303)	15.0000	$	(304)	-1.0000	$	(305)	-30.0000	$
(306)	-10.0000	$	(307)	25.0000	$	(308)	-1.0000	$
(309)	-30.0000	$	(310)	-10.0000	$	(311)	25.0000	$
(312)	1.0000	$	(313)	-30.0000	$	(314)	-20.0000	$
(315)	35.0000	$	(316)	0.0000	$	(317)	-70.0000	$
(318)	-10.0000	$	(319)	25.0000	$	(320)	1.0000	$
(321)	-70.0000	$	(322)	-20.0000	$	(323)	35.0000	$
(324)	0.0000	$	(325)	-70.0000	$	(326)	10.0000	$
(327)	25.0000	$	(328)	1.0000	$	(329)	-70.0000	$
(330)	20.0000	$	(331)	35.0000	$	(332)	0.0000	$
(333)	-30.0000	$	(334)	10.0000	$	(335)	25.0000	$
(336)	1.0000	$	(337)	-30.0000	$	(338)	20.0000	$
(339)	35.0000	$	(340)	0.0000	$	(341)	-30.0000	$
(342)	-10.0000	$	(343)	25.0000	$	(344)	-1.0000	$
(345)	-30.0000	$	(346)	-20.0000	$	(347)	35.0000	$
(348)	-1.0000	$	(349)	-30.0000	$	(350)	-20.0000	$
(351)	35.0000	$	(352)	1.0000	$	(353)	-30.0000	$
(354)	-10.0000	$	(355)	45.0000	$	(356)	0.0000	$
(357)	-70.0000	$	(358)	-20.0000	$	(359)	35.0000	$
(360)	1.0000	$	(361)	-70.0000	$	(362)	-10.0000	$
(363)	45.0000	$	(364)	0.0000	$	(365)	-70.0000	$
(366)	20.0000	$	(367)	35.0000	$	(368)	1.0000	$

Table II. MASTER-ASTER Array Printout for the Sample Target (continued)

```
(    369)      -70.0000 $ (    370)       10.0000 $ (    371)       45.0000 $
(    372)        0.0000 $ (    373)      -30.0000 $ (    374)       20.0000 $
(    375)       35.0000 $ (    376)        1.0000 $ (    377)      -30.0000 $
(    378)       10.0000 $ (    379)       45.0000 $ (    380)        0.0000 $
(    381)      -30.0000 $ (    382)      -20.0000 $ (    383)       35.0000 $
(    384)       -1.0000 $ (    385)      -30.0000 $ (    386)      -10.0000 $
(    387)       45.0000 $ (    388)       -1.0000 $ (    389)      -30.0000 $
(    390)      -10.0000 $ (    391)       45.0000 $ (    392)       -1.0000 $
(    393)      -30.0000 $ (    394)      -10.0000 $ (    395)       45.0000 $
(    396)       -1.0000 $ (    397)      -70.0000 $ (    398)      -10.0000 $
(    399)       45.0000 $ (    400)        1.0000 $ (    401)      -30.0000 $
(    402)      -10.0000 $ (    403)       45.0000 $ (    404)       -1.0000 $
(    405)      -70.0000 $ (    406)       10.0000 $ (    407)       45.0000 $
(    408)        1.0000 $ (    409)      -30.0000 $ (    410)      -10.0000 $
(    411)       45.0000 $ (    412)       -1.0000 $ (    413)      -30.0000 $
(    414)       10.0000 $ (    415)       45.0000 $ (    416)       -1.0000 $
(    417)      -30.0000 $ (    418)      -10.0000 $ (    419)       45.0000 $
(    420)       -1.0000 $ (    421)      -30.0000 $ (    422)      -10.0000 $
(    423)       45.0000 $ (    424)        6.0000 $ (    425)      -30.0000 $
(    426)      -10.0000 $ (    427)       45.0000 $ (    428)        5.0000 $
(    429)      -70.0000 $ (    430)        0.0000 $ (    431)       35.0000 $
(    432)        0.0000 $ (    433)      -11.0000 $ (    434)       11.0000 $
(    435)        0.0000 $ (    436)       11.0000 $ (    437)       11.0000 $
(    438)       40.0000 $ (    439)        0.0000 $ (    440)        0.0000 $
(    441)        0.0000 $ (    442)        0.0000 $ (    443)       24.0000 $
(    444)        0.0000 $ (    445)        0.0000 $ (    446)       28.0000 $
(    447)        0.0000 $ (    448)        7.5000 $ (    449)        0.0000 $
(    450)        5.0000 $ (    451)        0.0000 $ (    452)        0.0000 $
(    453)        0.0000 $ (    454)        0.0000 $ (    455)       52.0000 $
(    456)        5.0000 $ (    457)        0.0000 $ (    458)       -7.5000 $
(    459)       49.0000 $ (    460)       20.0000 $ (    461)        0.0000 $
(    462)      -12.0000 $ (    463)        1.0000 $ (    464)        0.0000 $
(    465)        0.0000 $ (    466)        0.0000 $ (    467)        0.0000 $
(    468)        1.0000 $ (    469)        3.0000 $ (    470)        2.0000 $
(    471)        2.0000 $ (    472)        0.0000 $ (    473)        7.5000 $
(    474)       49.0000 $ (    475)       20.0000 $ (    476)        0.0000 $
(    477)      -12.0000 $ (    478)        1.0000 $ (    479)        0.0000 $
(    480)        0.0000 $ (    481)        0.0000 $ (    482)        0.0000 $
(    483)        1.0000 $ (    484)        3.0000 $ (    485)        2.0000 $
(    486)        2.0000 $ (    487)       -2.0000 $ (    488)       -4.5000 $
(    489)       27.0000 $ (    490)       32.0000 $ (    491)        0.0000 $
(    492)      -12.0000 $ (    493)        3.0000 $ (    494)        2.0000 $
(    495)       -2.0000 $ (    496)        4.5000 $ (    497)       27.0000 $
(    498)       32.0000 $ (    499)        0.0000 $ (    500)      -12.0000 $
(    501)        3.0000 $ (    502)        2.0000 $ (    503)        0.0000 $
(    504)        0.0000 $ (    505)       48.0000 $ (    506)         .0417 $
(    507)        0.0000 $ (    508)        0.0000 $ (    509)        0.0000 $
(    510)         .0505 $ (    511)       -.0505 $ (    512)        0.0000 $
(    513)         .0505 $ (    514)         .0505 $ (    515)        1.0000 $
(    516)        0.0000 $ (    517)        0.0000 $ (    518)      -74.0000 $
(    519)      148.0000 $ (    520)        0.0000 $ (    521)        1.0000 $
(    522)        0.0000 $ (    523)      -35.0000 $ (    524)       70.0000 $
(    525)        0.0000 $ (    526)        0.0000 $ (    527)        1.0000 $
(    528)       13.0000 $ (    529)       34.0000 $ (

LREGD (    530 -    549)
(    530)    550       2 $ (    531)    552       1 $ (    532)    553       1 $
(    533)    554       1 $ (    534)    555       3 $ (    535)    558       7 $
(    536)    565       1 $ (    537)    566       1 $ (    538)    567       1 $
(    539)    568       1 $ (    540)    569       2 $ (    541)    571       3 $
(    542)    571       5 $ (    543)    576       2 $ (    544)    578       1 $
(    545)    579       1 $ (    546)    580       1 $ (    547)    581       1 $
(    548)    582       1 $ (    549)    583       1 $ (
```

Table II. MASTER-ASTER Array Printout for the Sample Target (continued)

```
LREGL (   550 -   583)
(    550)       4       1 $ (    551)       8       2 $ (    552)       4       2 $
(    553)       4       3 $ (    554)       4       4 $ (    555)       4       5 $
(    556)       8       6 $ (    557)       8      19 $ (    558)       4       6 $
(    559)       8      20 $ (    560)       8      19 $ (    561)       8       7 $
(    562)       8       8 $ (    563)       8       9 $ (    564)       8      10 $
(    565)       4       7 $ (    566)       4       8 $ (    567)       4       9 $
(    568)       4      10 $ (    569)       4      11 $ (    570)       8      12 $
(    571)       4      13 $ (    572)       8      15 $ (    573)       8      16 $
(    574)       8      17 $ (    575)       8      18 $ (    576)       4      14 $
(    577)       8      13 $ (    578)       4      15 $ (    579)       4      16 $
(    580)       4      17 $ (    581)       4      18 $ (    582)       4      19 $
(    583)       4      20 $ (

LREGMM(   584 -   703)
(    584)      20.5000 $ (    585)      22.5000 $ (    586)      -9.0000 $
(    587)       9.0000 $ (    588)      28.0000 $ (    589)      46.0000 $
(    590)      21.5000 $ (    591)      40.0000 $ (    592)      -6.0000 $
(    593)       6.0000 $ (    594)      33.5000 $ (    595)      44.0000 $
(    596)      75.0000 $ (    597)     100.0000 $ (    598)     -36.0000 $
(    599)      36.0000 $ (    600)      12.0000 $ (    601)      48.0000 $
(    602)    -100.0000 $ (    603)     -75.0000 $ (    604)     -36.0000 $
(    605)      36.0000 $ (    606)      12.0000 $ (    607)      48.0000 $
(    608)     -25.0000 $ (    609)      25.0000 $ (    610)     -15.0000 $
(    611)      15.0000 $ (    612)      33.0000 $ (    613)      63.0000 $
(    614)     -75.0000 $ (    615)      75.0000 $ (    616)     -36.0000 $
(    617)      36.0000 $ (    618)      12.0000 $ (    619)      48.0000 $
(    620)      48.0000 $ (    621)      72.0000 $ (    622)     -36.0000 $
(    623)     -28.0000 $ (    624)        .0000 $ (    625)      24.0000 $
(    626)      48.0000 $ (    627)      72.0000 $ (    628)      28.0000 $
(    629)      36.0000 $ (    630)        .0000 $ (    631)      24.0000 $
(    632)     -72.0000 $ (    633)     -48.0000 $ (    634)     -36.0000 $
(    635)     -28.0000 $ (    636)        .0000 $ (    637)      24.0000 $
(    638)     -72.0000 $ (    639)     -48.0000 $ (    640)      28.0000 $
(    641)      36.0000 $ (    642)        .0000 $ (    643)      24.0000 $
(    644)     -70.0000 $ (    645)     -30.0000 $ (    646)     -20.0000 $
(    647)      20.0000 $ (    648)      15.0000 $ (    649)      45.0000 $
(    650)************ $ (    651)************ $ (    652)************ $
(    653)************ $ (    654)************ $ (    655)************ $
(    656)      -5.0000 $ (    657)       5.0000 $ (    658)      -7.5000 $
(    659)       7.5000 $ (    660)      24.0000 $ (    661)      52.0000 $
(    662)      -5.0000 $ (    663)       5.0000 $ (    664)      -5.0000 $
(    665)       5.0000 $ (    666)      47.0000 $ (    667)      57.0000 $
(    668)       0.0000 $ (    669)      20.0000 $ (    670)      -9.5000 $
(    671)      -5.5000 $ (    672)      35.5000 $ (    673)      52.0000 $
(    674)       0.0000 $ (    675)      20.0000 $ (    676)       5.5000 $
(    677)       9.5000 $ (    678)      35.5000 $ (    679)      52.0000 $
(    680)      -3.0534 $ (    681)      30.7022 $ (    682)      -7.5000 $
(    683)      -1.5000 $ (    684)      13.1273 $ (    685)      29.8090 $
(    686)      -3.0534 $ (    687)      30.7022 $ (    688)       1.5000 $
(    689)       7.5000 $ (    690)      13.1273 $ (    691)      29.8090 $
(    692)     -24.0000 $ (    693)      24.0000 $ (    694)     -14.0000 $
(    695)      14.0000 $ (    696)      34.0000 $ (    697)      62.0000 $
(    698)     -74.0000 $ (    699)      74.0000 $ (    700)     -35.0000 $
(    701)      35.0000 $ (    702)      13.0000 $ (    703)      47.0000 $

LREGON(   704 -   823)
(    704)          12 $ (    705)           3 $ (    706)           7 $
(    707)           8 $ (    708)           2 $ (    709)           1 $
(    710)          15 $ (    711)          16 $ (    712)          18 $
(    713)          17 $ (    714)          14 $ (    715)          13 $
(    716)          19 $ (    717)           5 $ (    718)          11 $
(    719)           9 $ (    720)          10 $ (    721)          20 $
(    722)           6 $ (    723)           4 $ (    724)          12 $
```

Table II. MASTER-ASTER Array Printout for the Sample Target (continued)

```
(     725)              4 $ (     726)             10 $ (     727)              9 $
(     728)             11 $ (     729)             14 $ (     730)             13 $
(     731)             16 $ (     732)             15 $ (     733)              1 $
(     734)             19 $ (     735)              5 $ (     736)             18 $
(     737)             17 $ (     738)              2 $ (     739)              8 $
(     740)              7 $ (     741)             20 $ (     742)              6 $
(     743)              3 $ (     744)             12 $ (     745)              8 $
(     746)             10 $ (     747)             16 $ (     748)             18 $
(     749)             14 $ (     750)              2 $ (     751)             17 $
(     752)             13 $ (     753)              1 $ (     754)             15 $
(     755)             19 $ (     756)              5 $ (     757)             11 $
(     758)             20 $ (     759)              4 $ (     760)              7 $
(     761)              6 $ (     762)              9 $ (     763)              3 $
(     764)             12 $ (     765)              7 $ (     766)              9 $
(     767)             15 $ (     768)             17 $ (     769)             14 $
(     770)              2 $ (     771)             18 $ (     772)             13 $
(     773)              1 $ (     774)             16 $ (     775)             19 $
(     776)              5 $ (     777)             11 $ (     778)             20 $
(     779)              6 $ (     780)              3 $ (     781)              8 $
(     782)              4 $ (     783)             10 $ (     784)             12 $
(     785)             14 $ (     786)             16 $ (     787)             15 $
(     788)             19 $ (     789)              2 $ (     790)              5 $
(     791)              1 $ (     792)             13 $ (     793)             11 $
(     794)             18 $ (     795)             17 $ (     796)             20 $
(     797)              4 $ (     798)              3 $ (     799)              6 $
(     800)              7 $ (     801)              8 $ (     802)              9 $
(     803)             10 $ (     804)             12 $ (     805)              8 $
(     806)             10 $ (     807)              9 $ (     808)              7 $
(     809)             18 $ (     810)             17 $ (     811)              2 $
(     812)             11 $ (     813)              1 $ (     814)             20 $
(     815)              4 $ (     816)              6 $ (     817)              3 $
(     818)             16 $ (     819)             13 $ (     820)             15 $
(     321)             14 $ (     822)             19 $ (     823)              5 $

LENRPP(   824 -   829)
(     824)       -100.0000 $ (     825)        100.0000 $ (     826)        -36.0000 $
(     827)         36.0000 $ (     828)           .0000 $ (     829)         63.0000 $

LIRFO (   830 -   849)
(     830)     40       0 $ (     831)  1041       0 $ (     832)  100       0 $
(     833)    100       0 $ (     834)   101       0 $ (     835)  100       0 $
(     836)    651       0 $ (     837)   652       0 $ (     838)  653       0 $
(     839)    654       0 $ (     840)  2701       0 $ (     841)  111       0 $
(     842)   3031       0 $ (     843)  3031       0 $ (     844)  3031      0 $
(     845)   3031       0 $ (     846)  3031       0 $ (     847)  3031      0 $
(     848)      0       2 $ (     849)     3       2 $ (

FOUND     1 WARNING(S) IN GEOMETRY DESCRIPTION

TIME FOR INPUT PROCESSING      .255 SECONDS

LEAVE GENI

END OF RUN
```

Table III. Ordered Region Identification Table for the Sample Target

IDENTIFICATION TABLE BY ITEM

REGION	ITEM	SPACE	DESCRIPTION		
19	0	2	INSIDE AIR (BUBBLE)		ELL1
20	0	2	INSIDE AIR (BODY)	20	BOX
1	40	0	STEERING WHEEL	1-2	TOR
3	100	0	BODY-FRONT	3	ARB5
4	100	0	BODY-REAR	4	ARB8
6	100	0	BODY-CENTER	6-20-19-7-8-9-10	RPP
5	101	0	BUBBLE	5-6-19	ELL
12	111	0	DUMMY REGION	0	RAW
7	651	0	WHEEL RIGHT FRONT	7	RCC
8	652	0	WHEEL LEFT FRONT	8	RCC
9	653	0	WHEEL RIGHT REAR	9	RCC
10	654	0	WHEEL LEFT REAR	10	RCC
2	1041	0	STEERING SHAFT	2	ARB4
11	2701	0	ENGINE	11-12	ARS
13	3031	0	MAN-TORSO	13-15-16-17-18	REC
14	3031	0	MAN-HEAD	14-13	SPH
15	3031	0	MAN-ARM	15	TEC
16	3031	0	MAN-ARM	16	TEC
17	3031	0	MAN-LEG	17	TRC
18	3031	0	MAN-LEG	18	TRC

Table IV. Ordered Region RPP Equivalent Table for the Sample Target

COUNT	XMIN	A	XMAX	B	YMIN	C	YMAX	D	ZMIN	E	ZMAX	F
1	**********	12	**********	12	**********	12	**********	12	**********	12	**********	12
2	75.0000	3	-75.0000	4	28.0000	8	-28.0000	7	47.0000	14	24.0000	8
3	48.0000	7	-48.0000	10	28.0000	10	-28.0000	9	35.5000	16	24.0000	10
4	48.0000	8	-48.0000	9	5.5000	16	-5.5000	15	35.5000	15	24.0000	9
5	21.5000	2	-30.0000	11	1.5000	18	-1.5000	17	34.0000	19	24.0000	7
6	20.5000	1	5.0000	14	-5.0000	14	5.0000	14	33.5000	2	29.8090	18
7	0.0000	15	5.0000	13	-6.0600	2	6.0000	2	33.0000	5	29.8090	17
8	0.0000	16	20.0000	16	-7.5000	17	7.5000	18	28.0000	1	44.0000	2
9	-3.0534	18	20.0000	15	-7.5000	13	7.5000	13	24.0000	13	45.0000	11
10	-3.0534	17	22.5000	1	-9.0000	1	9.0000	1	15.0000	11	46.0000	1
11	-5.0000	14	24.0000	19	-9.5000	15	9.5000	16	13.1273	18	47.0000	20
12	-5.0000	13	25.0000	5	-14.0000	19	14.0000	19	13.1273	17	48.0000	4
13	-24.0000	19	30.7022	18	-15.0000	5	15.0000	5	13.0000	20	48.0000	6
14	-25.0000	5	30.7022	17	-20.0000	11	20.0000	11	12.0000	4	48.0000	3
15	-70.0000	11	40.0000	2	-35.0000	20	35.0000	20	12.0000	3	52.0000	16
16	-72.0000	9	72.0000	8	-36.0000	4	36.0000	6	12.0000	6	52.0000	13
17	-72.0000	10	72.0000	7	-36.0000	7	36.0000	3	.0000	7	52.0000	15
18	-74.0000	20	74.0000	20	-36.0000	6	36.0000	8	.0000	8	57.0000	14
19	-75.0000	6	75.0000	6	-36.0000	9	36.0000	4	.0000	9	62.0000	19
20	-100.0000	4	100.0000	3	-36.0000	3	36.0000	10	.0000	10	63.0000	5

LOCATION OF REGION RPP EQUIV LREGMM = 584
LOCATION OF REGION LIST LREGON = 704
INDEX FOR MIDDLE OF LIST MIDDLE = 16
TOTAL STORAGE FOR REGION MIN AND MAX = 240

Table V. A Solid RPP Equivalent Table for the Sample Target

SOLID	XMIN	XMAX	YMIN	YMAX	ZMIN	ZMAX
1	20.5000	22.5000	-9.0000	9.0000	28.0000	46.0000
2	21.5000	40.0000	-6.0000	6.0000	33.5000	44.0000
3	75.0000	100.0000	-36.0000	36.0000	12.0000	48.0000
4	-100.0000	-75.0000	-36.0000	36.0000	12.0000	48.0000
5	-25.0000	25.0000	-15.0000	15.0000	33.0000	63.0000
6	-75.0000	75.0000	-36.0000	36.0000	12.0000	48.0000
7	48.0000	72.0000	-36.0000	-28.0000	.0000	24.0000
8	48.0000	72.0000	28.0000	36.0000	.0000	24.0000
9	-72.0000	-48.0000	-36.0000	-28.0000	.0000	24.0000
10	-72.0000	-48.0000	28.0000	36.0000	.0000	24.0000
11	-70.0000	-30.0000	-20.0000	20.0000	15.0000	45.0000
12	**********	**********	**********	**********	**********	**********
13	-5.0000	5.0000	-7.5000	7.5000	24.0000	52.0000
14	-5.0000	5.0000	-5.0000	5.0000	47.0000	57.0000
15	0.0000	20.0000	-9.5000	-5.5000	35.5000	52.0000
16	0.0000	20.0000	5.5000	9.5000	35.5000	52.0000
17	-3.0534	30.7022	-7.5000	-1.5000	13.1273	29.8090
18	-3.0534	30.7022	1.5000	7.5000	13.1273	29.8090
19	-24.0000	24.0000	-14.0000	14.0000	34.0000	62.0000
20	-74.0000	74.0000	-35.0000	35.0000	13.0000	47.0000

If Column 10 of the Control card is not zero, the Solid, Region, Region RPP Equivalent and Region Identification Tables are not printed. Table VI is an example of the output (compressed for display) when this option is used with the COM-GEOM description of the Sample Target.

The tolerance for overlaps (TOL) and the tolerance for line-of-sight (TOLLOS) are specified in card columns 31-40 and 41-50, respectively, of the Control card. Tolerance for overlaps is the maximum distance along a ray two or more regions can occupy the same location without generating an error. Tolerance for line-of-sight is the maximum distance along a ray or gap between two components will be ignored. Previously stated in BRL 1802, these variables were fixed at .0001 and could only be changed by altering the GIFT code.

The Void Space Code, the Phantom Item Code and the Signal Code for end of components along a ray are specified in card columns 51-55, 56-60 and 61-65, respectively. If the value of these numbers is equal to zero, the values of 1, 111 and 9 are assigned to the Void Space Code, the Phantom Code and the Signal Code for end of components along a ray, respectively. These variables will be discussed in more detail later in this report.

C. GENI Output

The GENI portion of the GIFT code reads, performs geometry tests, processes and stores the COM-GEOM target description data. Table VII contains the output of GENI for the Title card, the Target Specification card and Solid Table of the COM-GEOM description of the Sample Target. Large capital letters (A-F) are added to the printout to identify sections. The first line labeled "A" is a print of the first 60 card columns of the Title card of the COM-GEOM description. The second line labeled "A" between parenthesis is a print of Columns 79 and 80 of the Title card. The data in columns 79 and 80 of the Title card represent the units (IN = inches) that the COM-GEOM description data is described and is not mentioned in BRL Report 1802. The three lines to the right of "B" are the number of solids, regions and "surrounding RPPs" specified by the Target Specification card.

The heading "DESCRIPTION OF SOLIDS" labeled "C" precedes the lines of the printout containing the Solid Table data. The solid numbers punched on the Solid Table input cards are printed next to a sequential number generated by the GIFT code (1 1, 2 2, 3 3,..., 20 20). When a generated number differs from the solid number, an error in the numbering or in the ordering of the Solid Table cards exist.

The two lines preceded by "D" are storage location numbers. The three lines preceded by "E" display the storage requirements for each solid type in the Solid Table. For example, in the "RPP" column, the number of RPPs is 1 and the number of words of storage for the RPPs is 6.

Table VI. Output Generated for the Sample Target when the No Print Option is Specified on the Control Card (Compressed for Display)

```
GIFT PROGRAM - CDC VERSION
PROGRAM SET 1977 AUG 11
EXECUTION DATE / TIME   09/18/78  /  14.42.33.


BEGIN EXECUTION


OPTION SET TO SUPPRESS GENI PROCESSING PRINTOUT

ENTER GENI TO PROCESS GEOMETRY

TITLE - SAMPLE INPUT FOR GIFT

TARGET UNITS (IN)

   NO. OF RECTANGULAR PARALLELEPIPEDS     0
   NO. OF SOLIDS                         20
   MAX NO. OF REGIONS                    20

LOCATION OF SOLID POINTERS      LBODY =          1
LOCATION OF SOLID DATA          LSOLID =        21

                  RPP   BOX   SPH   RCC   REC   TRC   ELL   RAW   ARB   TEC   TOR   ARS
        NUMBER      1     1     1     4     1     2     2     1     3     2     1     1
        STORAGE     6    15     4    28    12    16    24    12    63    30    11   288

STORAGE FOR SOLID DATA                        509
STORAGE FOR SOLID POINTERS                     20
TOTAL STORAGE FOR SOLIDS                      529

                                  REGION COMBINATION DATA


LOCATION OF REGION POINTERS     LREGD  =        530
LOCATION OF REGION LIST         LREGL  =        550

NUMBER OF DESCRIPTORS                          35
STORAGE FOR REGION POINTERS                    20
TOTAL STORAGE FOR REGIONS                      55

                               REGION RPP EQUIVALENTS

REGION          XMIN         XMAX         YMIN         YMAX         ZMIN         ZMAX

                     ** DIAGNOSTIC ** THE FOLLOWING REGIONS ARE NULL

  12

LOCATION OF REGION RPP EQUIV    LREGMM =        585
LOCATION OF REGION LIST         LREGON =        705
INDEX FOR MIDDLE OF LIST        MIDDLE =         16
TOTAL STORAGE FOR REGION MIN AND MAX   =        240

                                 ENCLOSING  RPP

        XMIN          XMAX          YMIN          YMAX          ZMIN          ZMAX

   -100.00000     100.00000      -36.00000      36.00000       .00000      63.00000

LOCATION OF ENCLOSING RPP       LENRPP =        825



IDENTIFICATION TABLE
REGION      ITEM     SPACE      DESCRIPTION


LOCATION OF IDENT TABLE         LIRFO  =        831
STORAGE FOR IDENT TABLE                         20

LOCATION ALPHA REG DESCRIPTION  LDES   =        911
STORAGE FOR ALPHA REGION DESCRIPTION            80
```

Table VI. Output Generated for the Sample Target when the No Print Option is Specified on the Control Card (Compressed for Display)(Con't)

```
STORAGE SUMMARY


NUMBER OF SOLIDS                                    20

LOCATION OF SOLID POINTERS          LBODY  =         1
LOCATION OF SOLID DATA              LSOLID =        21

                  RPP   BOX   SPH   RCC   REC   TRC   ELL   RAW   ARB   TEC   TOR   ARS
      NUMBER        1     1     1     4     1     2     2     1     3     2     1     1
      STORAGE       6    15     4    28    12    16    24    12    63    30    11   288

STORAGE FOR SOLID DATA                             509
STORAGE FOR SOLID POINTERS                          20
TOTAL STORAGE FOR SOLIDS                           529


NUMBER OF REGIONS                                   20

LOCATION OF REGION POINTERS         LREGD  =       530
LOCATION OF REGION LIST             LREGL  =       550

NUMBER OF DESCRIPTORS                               35
STORAGE FOR REGION POINTERS                         20
TOTAL STORAGE FOR REGIONS                           55


LOCATION OF REGION RPP EQUIV        LREGMM =       585
LOCATION OF REGION LIST             LREGON =       705
INDEX FOR MIDDLE OF LIST            MIDDLE =        16
TOTAL STORAGE FOR REGION MIN AND MAX   =           240


LOCATION OF ENCLOSING RPP           LENRPP =       825


LOCATION OF IDENT TABLE             LIRFO  =       831
STORAGE FOR IDENT TABLE                             20

LOCATION OF RIN  STORAGE            LRIN   =       851
LOCATION OF ROUT STORAGE            LROT   =       871
LOCATION OF SURFACES/RAY NUM        LIO    =       891

LOCATION ALPHA REG DESCRIPTION      LDES   =       911
STORAGE FOR ALPHA REGION DESCRIPTION                80

LOC NEXT AVAILABLE STORAGE          LEGFOM =       991

TOTAL STORAGE FOR GEOMETRY DATA                    850
TOTAL WORKING STORAGE                               60
TOTAL STORAGE ALPHA REGION DESCRIPTION              80
TOTAL STORAGE IN MASTER-ASTER                      990


FOUND     1 WARNING(S) IN GEOMETRY DESCRIPTION

TIME FOR INPUT PROCESSING       .056 SECONDS

LEAVE GENI
```

Table VII. Output of GENI for the Title Card, Target Specification Card and Solid Table of the Sample Target

```
ENTER GENI TO PROCESS GEOMETRY

GEOMETRY INPUT FROM TAPE  3

TITLE - SAMPLE INPUT FOR GIFT

A.  TARGET UNITS (IN)

B.     NO. OF RECTANGULAR PARALLELEPIPEDS     0
       NO. OF SOLIDS                         20
       MAX NO. OF REGIONS                    20

NO RPP DATA

C.                                                    DESCRIPTION OF SOLIDS
    1  1    TOR          21.5000      0.0000      37.0000      1.0000      0.0000      0.0000    STEERING
                         8.0000      1.0000                                                     WHEEL
    2  2    ARB4         21.5000     -6.0000      33.5000     21.5000      6.0000     33.5000    CENTER
                        21.5000      0.0000      44.0000     40.0000      0.0000     37.0000    STEERING
                        1 2 3 0      4 1 2 0      4 2 3 0     4 3 1 0      0 0 0 0    0 0 0 0   GENERATED
                           NUMBER OF POINTS 4          NUMBER OF FACES 4
    3  3    ARB5         75.0000    -36.0000      12.0000     75.0000     36.0000     12.0000    FRONT
                        75.0000     36.0000      48.0000     75.0000    -36.0000     48.0000      3-2
                       100.0000      0.0000      12.0000                                          3-3
                        1 2 3 4      5 1 2 0      5 2 3 0     5 3 4 0     5 4 1 0    0 0 0 0   GENERATED
                           NUMBER OF POINTS 5          NUMBER OF FACES 5
    4  4    ARB8        -75.0000    -36.0000      12.0000    -75.0000     36.0000     12.0000    REAR
                       -75.0000     36.0000      48.0000    -75.0000    -36.0000     48.0000      4-2
                      -100.0000    -24.0000      12.0000   -100.0000     24.0000     12.0000      4-3
                      -100.0000     24.0000      20.0000   -100.0000    -24.0000     20.0000      4-4
                        1 2 3 4      5 6 7 8      1 5 8 4     2 3 7 6     1 2 6 5    4 3 7 8   GENERATED
    5  5    ELL  F       20.0000      0.0000      48.0000    -20.0000      0.0000     48.0000    BUBBLE
                        50.0000
    6  6    RPP         -75.0000     75.0000     -36.0000     36.0000     12.0000     48.0000    BODY
    7  7    RCC          60.0000    -36.0000      12.0000      0.0000      8.0000      0.0000    WHEEL
                        12.0000
    8  8    RCC          60.0000     36.0000      12.0000      0.0000     -8.0000      0.0000    WHEEL
                        12.0000
    9  9    RCC         -60.0000    -36.0000      12.0000      0.0000      8.0000      0.0000    WHEEL
                        12.0000
   10 10    RCC         -60.0000     36.0000      12.0000      0.0000     -8.0000      0.0000    WHEEL
                        12.0000
   11 11    ARS              NUMBER OF POINTS READ DIRECTLY     ND=          0
                             NUMBER OF CURVES                   M=          6
                             NUMBER OF POINTS PER CURVE         N=          5
                             NUMBER OF POINTS IN                MN=         30
                             NUMBER OF POINTS STORED   NS=2N(M-1)=         50
                             TOTAL NUMBER OF POINTS      NP=ND+NS=         50
                             TOTAL STORAGE             NSTR=4NP+8=        208
                       -30.0000    -10.0000      15.0000    -30.0000    -10.0000     15.0000    11-2
                       -30.0000    -10.0000      15.0000    -30.0000    -10.0000     15.0000    11-3
                       -30.0000    -10.0000      15.0000                                       11-4

                       -30.0000    -10.0000      15.0000    -30.0000    -10.0000     15.0000    11-5
```

Table VII. Output of GENI for the Title Card, Target Specification Card and Solid Table of the Sample Target (continued)

```
-70.0000    10.0000    15.0000   -30.0000    10.0000    15.0000   11-6
-30.0000   -10.0000    15.0000                                     11-7

-30.0000   -10.0000    25.0000   -70.0000   -10.0000    25.0000   11-8
-70.0000    10.0000    25.0000   -30.0000    10.0000    25.0000   11-9
-30.0000   -10.0000    25.0000                                     11-10

-30.0000   -20.0000    35.0000   -70.0000   -20.0000    35.0000   11-11
-70.0000    20.0000    35.0000   -30.0000    20.0000    35.0000   11-12
-30.0000   -20.0000    35.0000                                     11-13

-30.0000   -10.0000    45.0000   -70.0000   -10.0000    45.0000   11-14
-70.0000    10.0000    45.0000   -30.0000    10.0000    45.0000   11-15
-30.0000   -10.0000    45.0000                                     11-16

-30.0000   -10.0000    45.0000   -30.0000   -10.0000    45.0000   11-17
-30.0000   -10.0000    45.0000   -30.0000   -10.0000    45.0000   11-18
-30.0000   -10.0000    45.0000                                     11-19

      XMIN        XMAX        YMIN        YMAX        ZMIN        ZMAX
  -70.0000    -30.0000    -20.0000     20.0000     15.0000     45.0000

CURVE -    1   2   3   4   5   6
POINT

    1      1   1   5   9  13  13
    2      1   2   6  10  14  13
    3      1   3   7  11  15  13
    4      1   4   8  12  16  13
    5      1   1   5   9  13  13

          NUMBER OF TRIANGLES DESCRIBED                  48
          NUMBER OF NON-DEGENERATE TRIANGLES             28

12 12  RAW   -70.0000     0.0000    35.0000     0.0000   -11.0000    11.0000   (ENGINE)
               0.0000    11.0000    11.0000    40.0000     0.0000     0.0000
13 13  REC     0.0000     0.0000    24.0000     0.0000     0.0000    28.0000   TRUNK
               0.0000     7.5000     0.0000     5.0000     0.0000     0.0000
14 14  SPH     0.0000     0.0000    52.0000     5.0000                         HEAD
15 15  TEC     0.0000    -7.5000    49.0000    20.0000     0.0000   -12.0000   ARM
               0.0000     0.0000     3.0000     0.0000     2.0000     0.0000    15-2
               2.0000                                                         15-3
16 16  TEC     0.0000     7.5000    49.0000    20.0000     0.0000   -12.0000   ARM
               0.0000     0.0000     3.0000     0.0000     2.0000     0.0000    16-2
               2.0000                                                         16-3
17 17  TRC    -2.0000    -4.5000    27.0000    32.0000     0.0000   -12.0000   LEG
               3.0000     2.0000
18 18  TRC    -2.0000     4.5000    27.0000    32.0000     0.0000   -12.0000   LEG
               3.0000     2.0000
19 19  LLL  V  0.0000     0.0000    48.0000    24.0000     0.0000     0.0000   (1.0)
              14.0000
20 20  BOX   -74.0000   -35.0000    13.0000   146.0000     0.0000     0.0000   (1.0)
               0.0000    70.0000     0.0000     0.0000     0.0000    34.0000
```

Table VII. Output of GENI for the Title Card, Target Specification Card and Solid Table of the Sample Targer (continued)

D.

LOCATION OF SOLID POINTERS	LBODY =	1
LOCATION OF SOLID DATA	LSOLID =	21

E.

	RPP	BOX	SPH	RCC	REC	TRC	ELL	RAW	APB	TEC	TOR	ARS
NUMBER	1	1	1	4	1	2	2	1	3	2	1	1
STORAGE	6	15	4	28	12	16	24	12	63	30	11	288

F.

STORAGE FOR SOLID DATA	509
STORAGE FOR SOLID POINTERS	20
TOTAL STORAGE FOR SOLIDS	529

The RCC column may be interpreted as: "4 RCCs were used which required 28 words of storage; therefore, 28 divided by 4 or 7 words of storage is required for each RCC."

The three lines following "F" display the storage requirements for the Solid Table. The "TOTAL STORAGE" which is probably the only one of interest to most users, states that 529 words of storage were required for the Solid Table of the COM-GEOM description of the sample target.

Table VIII displays the Region Table for the COM-GEOM description of the Sample Target as printed by GENI. The twenty lines following the line "REGION COMBINATION DATA" is the Region Table data. The GIFT code generates a number which is printed next to the region number as they appear on the input cards. A difference between a generated number and an inputted region number indicates errors in the numbering of the Region Table.

The Region Table data is followed by storage and location numbers. The total storage for the Region Table of the COM-GEOM description of the Sample Target is 54 words.

Table IX displays the Region RPP Table created for the COM-GEOM description of the Sample Target. In the far right column of Table IX, the word "COMPUTED" is printed when the RPP values for the region was computed by the GIFT code. The word "INPUTTED" is printed when the XMIN, XMAX, YMIN, YMAX, ZMIN and XMAX values are read from an inputted Region RPP card. The line for region 12 contains values too large for the format which indicates that it is a null region. The RPP values for any purposely defined null region are meaningless; however, if the null diagnostic message is unexpectedly printed for a region, either the recorded values of solids referenced by the region or the data within the region's description is in error. The values within the region RPP Table provide the x, y, and z location of each region. The user should review this table to ensure that every region is correctly located. The two lines after the heading "ENCLOSING RPP" provide the dimensions of an RPP which encloses or contains the entire target: the minimum x is -100.0, the maximum x is 100.0, the minimum y is -36.0, the maximum y is 36.0, the minimum z is 0.0 and the maximum z is 63.0. The x, y and z values for the "ENCLOSING RPP" are the smallest XMIN, YMIN, and ZMIN, and the largest XMAX, YMAX, and ZMAX in the Region RPP Equivalent Table; thus, these values appear in the last row of the Ordered Region RPP Equivalent Table (Table IV, row where "COUNT" is 20).

Table X displays the Region Identification Table of the COM-GEOM description of the Sample Target. A review of the figure is recommended because it can help detect air space and item code numbers that are incorrectly recorded in the Region Identification Table.

Table XI is the Storage Summary Table for the COM-GEOM description of the Sample Target. The Storage Summary Table lists the storage and

Table VIII. GENI Output for the Region Table of the Sample Target

REGION COMBINATION DATA

1	1	1	-2	0	0	0	0	0	0	0
2	2	2	0	0	0	0	0	0	0	0
3	3	3	0	0	0	0	0	0	0	0
4	4	4	0	0	0	0	0	0	0	0
5	5	5	-6	-19	0	0	0	0	0	0
6	6	6	-20	-19	-7	-8	-9	-10	0	0
7	7	7	0	0	0	0	0	0	0	0
8	8	8	0	0	0	0	0	0	0	0
9	9	9	0	0	0	0	0	0	0	0
10	10	10	0	0	0	0	0	0	0	0
11	11	11	-12	0	0	0	0	0	0	0
12	12	0	0	0	0	0	0	0	0	0
13	13	13	-15	-16	-17	-18	0	0	0	0
14	14	14	-13	0	0	0	0	0	0	0
15	15	15	0	0	0	0	0	0	0	0
16	16	16	0	0	0	0	0	0	0	0
17	17	17	0	0	0	0	0	0	0	0
18	18	18	0	0	0	0	0	0	0	0
19	19	19	0	0	0	0	0	0	0	0
20	20	20	0	0	0	0	0	0	0	0

LOCATION OF REGION POINTERS	LREGD =	530
LOCATION OF REGION LIST	LREGL =	550
NUMBER OF DESCRIPTORS		34
STORAGE FOR REGION POINTERS		20
TOTAL STORAGE FOR REGIONS		54

Table IX. GENI Output of the Region RPP Equivalent Table and Enclosing RPP for the Sample Target

REGION	XMIN	XMAX	YMIN	YMAX	ZMIN	ZMAX	
1	20.5000	22.5000	-9.0000	9.0000	28.0000	46.0000	COMPUTED
2	21.5000	40.0000	-6.0000	6.0000	33.5000	44.0000	COMPUTED
3	75.0000	100.0000	-36.0000	36.0000	12.0000	48.0000	COMPUTED
4	-100.0000	-75.0000	-36.0000	36.0000	12.0000	48.0000	COMPUTED
5	-25.0000	25.0000	-15.0000	15.0000	33.0000	63.0000	COMPUTED
6	-75.0000	75.0000	-36.0000	36.0000	12.0000	48.0000	COMPUTED
7	48.0000	72.0000	-36.0000	-28.0000	.0000	24.0000	COMPUTED
8	48.0000	72.0000	28.0000	36.0000	.0000	24.0000	COMPUTED
9	-72.0000	-48.0000	-36.0000	-28.0000	.0000	24.0000	COMPUTED
10	-72.0000	-48.0000	28.0000	36.0000	.0000	24.0000	COMPUTED
11	-70.0000	-30.0000	-20.0000	20.0000	15.0000	45.0000	COMPUTED
12	**********	**********	**********	**********	**********	**********	COMPUTED
** DIAGNOSTIC **	REGION	12 IS A NULL REGION					
13	-5.0000	5.0000	-7.5000	7.5000	24.0000	52.0000	COMPUTED
14	-5.0000	5.0000	-5.0000	5.0000	47.0000	57.0000	COMPUTED
15	0.0000	20.0000	-9.5000	-5.5000	35.5000	52.0000	COMPUTED
16	0.0000	20.0000	5.5000	9.5000	35.5000	52.0000	COMPUTED
17	-3.0534	30.7022	-7.5000	-1.5000	13.1273	29.8090	COMPUTED
18	-3.0534	30.7022	1.5000	7.5000	13.1273	29.8090	COMPUTED
19	-24.0000	24.0000	-14.0000	14.0000	34.0000	62.0000	COMPUTED
20	-74.0000	74.0000	-35.0000	35.0000	13.0000	47.0000	COMPUTED

ENCLOSING RPP

XMIN	XMAX	YMIN	YMAX	ZMIN	ZMAX
-100.00000	100.00000	-36.00000	36.00000	.00000	63.00000

LOCATION OF ENCLOSING RPP LENRPP = 824

Table X. GENI Output for Region Identification Table of the Sample Target

IDENTIFICATION TABLE

REGION	ITEM	SPACE	DESCRIPTION		
1	40	0	STEERING WHEEL	1-2	TOR
2	1041	0	STEERING SHAFT	2	ARB4
3	100	0	BODY-FRONT	3	ARB5
4	100	0	BODY-REAR	4	ARB8
5	101	0	BUBBLE	5-6-19	ELL
6	100	0	BODY-CENTER	6-20-19-7-8-9-10	RPP
7	651	0	WHEEL RIGHT FRONT	7	RCC
8	652	0	WHEEL LEFT FRONT	8	RCC
9	653	0	WHEEL RIGHT REAR	9	RCC
10	654	0	WHEEL LEFT REAR	10	RCC
11	2701	0	ENGINE	11-12	ARS
12	111	0	DUMMY REGION	0	RAW
13	3031	0	MAN-TORSO	13-15-16-17-18	REC
14	3031	0	MAN-HEAD	14-13	SPH
15	3031	0	MAN-ARM	15	TEC
16	3031	0	MAN-ARM	16	TEC
17	3031	0	MAN-LEG	17	TRC
18	3031	0	MAN-LEG	18	TRC
19	0	2	INSIDE AIR (BUBBLE)		ELL1
20	0	2	INSIDE AIR (BODY)	20	BOX

LOCATION OF IDENT TABLE LIRFO = 830
STORAGE FOR IDENT TABLE 20

LOCATION ALPHA REG DESCRIPTION LDES = 910
STORAGE FOR ALPHA REGION DESCRIPTION 80

Table XI. Storage Summary Table for the Sample Target

STORAGE SUMMARY

NUMBER OF SOLIDS		20
LOCATION OF SOLID POINTERS	LBODY =	1
LOCATION OF SOLID DATA	LSOLID =	21

	RPP	BOX	SPH	RCC	REC	TRC	ELL	RAW	ARB	TEC	TOR	ARS
NUMBER	1	1	1	4	1	2	2	1	3	2	1	1
STORAGE	6	15	4	28	12	16	24	12	63	30	11	288

STORAGE FOR SOLID DATA		509
STORAGE FOR SOLID POINTERS		20
TOTAL STORAGE FOR SOLIDS		529
NUMBER OF REGIONS		20
LOCATION OF REGION POINTERS	LREGD =	530
LOCATION OF REGION LIST	LREGL =	550
NUMBER OF DESCRIPTORS		34
STORAGE FOR REGION POINTERS		20
TOTAL STORAGE FOR REGIONS		54
LOCATION OF REGION RPP EQUIV	LREGMM =	584
LOCATION OF REGION LIST	LREGON =	704
INDEX FOR MIDDLE OF LIST	MIDDLE =	16
TOTAL STORAGE FOR REGION MIN AND MAX	=	240
LOCATION OF ENCLOSING RPP	LENRPP =	824
LOCATION OF IDENT TABLE	LIRFO =	830
STORAGE FOR IDENT TABLE		20
LOCATION OF RIN STORAGE	LRIN =	850
LOCATION OF ROUT STORAGE	LROT =	870
LOCATION OF SURFACES/RAY NUM	LIO =	890
LOCATION ALPHA REG DESCRIPTION	LDES =	910
STORAGE FOR ALPHA REGION DESCRIPTION		80
LOC NEXT AVAILABLE STORAGE	LEGEOM =	990
TOTAL STORAGE FOR GEOMETRY DATA		849
TOTAL WORKING STORAGE		60
TOTAL STORAGE ALPHA REGION DESCRIPTION		80
TOTAL STORAGE IN MASTER-ASTER		989

location of the different tables of the COM-GEOM description. The storage numbers can be used to determine the minimum number of computer words required for the MASTER-ASTER array to store the target description input data. Three values must be computed to determine the minimum memory size required for the target description input data. The first minimum storage value is equal to the value of LDES minus one. For the sample target, the first value is 909. The second minimum storage value is equal to the product six times (x) the number of solids plus the value of LREGON minus one. For the sample target, the second value equals 6 x 20 + 704 - 1 = 823. A computer constant (K) is required to compute the third value. For the CDC computer, K equals 5; for the UNIVAC computer, K equals 8; and for the IBM computer, K equals 11. The third value is equal to the product of the constant K times (x) the number of regions plus the value of LRIN minus one. The third minimum storage value for the COM-GEOM description of the sample target using the CDC computer equals 5 x 20 + 850 - 1 or 949. The largest of the three values is the minimum value that the variable NDQ and the ASTER array (discussed in BRL Report 1802) can be assigned when the Ordered Region Identification Table option (Column 7 on Control card) is specified. When the Ordered Region Identification Table option is not used, the variable NDQ and ASTER array must be equal to or larger than the maximum of the first two values. If the storage of the alphanumeric data (Columns 41-80) of the Region Identification Table is desired, the minimum value of NDQ is equal to LDES plus K-1 times the number of regions minus one. The minimum storage value for the alphanumeric data of the Region Identification Table of the COM-GEOM description of the sample target using the CDC computer is 910 + (5-1) 20 - 1 or 989.

D. GENI Checking Process

As the GENI portion of the GIFT code checks the COM-GEOM description, a warning or error message may be printed. A warning message notifies the user of a potential problem in the COM-GEOM data and that a change may be necessary. A warning does not terminate the execution of the GIFT code. However, an error will terminate the execution of the GIFT code and the COM-GEOM description will necessarily have to be changed.

Table XIII contains a printout of a Solid Table listed in Table XII which has errors introduced to display warning messages. Comparing the code generated solid numbers to the input solid numbers (1 12, 2 18, 3 17,..., 8 4) reveals that the input solid numbers are not consecutive. The code generated and input solid numbers can differ only when the purpose of a run is to test the Solid Table for errors. The remaining messages printed in Table XIII are explained in the paragraphs which follow.

Table XII. Input Used to Generate Solid Table Warning Message

8 SOLIDS USED TO GENERATE WARNING MESSAGES

		8		3		
12RAW	-70.	.	35.	.	11.	11.
12	11.	11.	11.	40.	.	.
18TRC	-2.	4.5	27.	32.	.	-12.
18	2.	2.	.	.	.	.
17TRC	-2.	-4.5	27.	32.	.	-12.
17	.	2.	.	.	.	.
15TEC	.	-7.5	49.	20.	0.	-12.
15	.	.	3.	.	3.	.
15	1.	.	.	.	.	.
13REC	.	.	24.	.	.	28.
13	.	7.5	.	7.5	.	.
16TEC	.	7.5	49.	20.	.	-12.
16	.	.	3.	.	2.	.
16	.7	.	.	.	.	.
21TEC	-2.	-4.5	27.	32.	.	.
21	.	.	3.	.	3.	.
21	1.5	.	.	.	.	.
4ARBB	-75.	-36.	12.	-75.	36.	12.
4	-75.	36.	48.	-75.	-36.	48.
4	-100.	-24.	12.	-100.	24.	12.
4	-100.	20.	24.	-100.	-24.	20.

Table XIII. GENI Output of a Solid Table Containing Warning Messages

```
ENTER GENI TO PROCESS GEOMETRY

TITLE - 6 SOLIDS USED TO GENERATE WARNING MESSAGES

TARGET UNITS (  )

   NO. OF RECTANGULAR PARALLELEPIPEDS     0
   NO. OF SOLIDS                          8
   MAX NO. OF REGIONS                     3

NO RPP DATA

                                                    DESCRIPTION OF SOLIDS
     1  12  RAW            -70.0000      0.0000      35.0000      0.0000      11.0000      11.0000
                            11.0000     11.0000      11.0000     40.0000       0.0000       0.0000

WARNING IN DESCRIPTION OF RAW    SOLID NUMBER    1
    VECTOR      0.0000      11.0000      11.0000  IS NOT PERPENDICULAR TO
    VECTOR     11.0000      11.0000      11.0000  WITHIN .5 DEGREES
    ERROR IS    54.736   DEGREES

WARNING IN DESCRIPTION OF RAW    SOLID NUMBER    1
    VECTOR     11.0000      11.0000      11.0000  IS NOT PERPENDICULAR TO
    VECTOR     40.0000       0.0000       0.0000  WITHIN .5 DEGREES
    ERROR IS    35.264   DEGREES

     2  18  TRC            -2.0000       4.5000      27.0000      32.0000       0.0000     -12.0000
                            2.0000       2.0000
                          RADIUS OF BASE .EQ. RADIUS OF TOP  -  CYLINDER
     3  17  TRC            -2.0000      -4.5000      27.0000      32.0000       0.0000     -12.0000
                            0.0000       2.0000
                          RADIUS OF BASE .LT. RADIUS OF TOP  -  CONE IS UPSIDE DOWN
                          RADIUS OF TOP .EQ. 0 (APEX)
     4  15  TEC            0.0000      -7.5000      49.0000      20.0000       0.0000     -12.0000
                            0.0000       0.0000       3.0000       0.0000       3.0000       0.0000
                            1.0000
                          MAJOR AXIS .EQ. MINOR AXIS - BASES ARE CIRCULAR
                          AXES OF BASE .EQ. AXES OF TOP  -  CYLINDER
     5  13  REC            0.0000       0.0000      24.0000       0.0000       0.0000      26.0000
                            0.0000       7.5000       0.0000       7.5000       0.0000       0.0000
                          MAJOR AXIS .EQ. MINOR AXIS - BASES ARE CIRCULAR
     6  16  TEC            0.0000       7.5000      49.0000      20.0000       0.0000     -12.0000
                            0.0000       0.0000       3.0000       0.0000       2.0000       0.0000
                             .7000
                          AXES OF BASE .LT. AXES OF TOP  -  CONE IS UPSIDE DOWN
     7  21  TEC            -2.0000      -4.5000      27.0000      32.0000       0.0000       0.0000
                            0.0000       0.0000       3.0000       0.0000       3.0000       0.0000
                            1.5000
                          MAJOR AXIS .EQ. MINOR AXIS - BASES ARE CIRCULAR
                          HEIGHT VECTOR IS PERPENDICULAR TO BASE
     8   4  ARB8         -75.0000     -36.0000      12.0000     -75.0000      36.0000      12.0000
                          -75.0000      36.0000      48.0000     -75.0000     -36.0000      48.0000
                         -100.0000     -24.0000      12.0000    -100.0000      24.0000      12.0000

                         -100.0000      20.0000      24.0000    -100.0000     -24.0000      20.0000
                           1 2 3 4      5 6 7 8      1 5 8 4      2 3 7 6      1 2 6 5      4 3 7 8

WARNING IN DESCRIPTION OF ARB    SOLID NUMBER    8
    WARNING IN DESCRIPTION OF FACE 4      ( 2 3 7 6)     FACE IS PROCESSED AS ( 2 3 7 6)
        FOUR POINTS NOT IN A PLANE    DN=  3.369

WARNING IN DESCRIPTION OF ARB    SOLID NUMBER    8
    WARNING IN DESCRIPTION OF FACE 6      ( 4 3 7 8)     FACE IS PROCESSED AS ( 4 3 7 8)
        FOUR POINTS NOT IN A PLANE    DN=  2.886

LOCATION OF SOLID POINTERS      LBODY =        1
LOCATION OF SOLID DATA          LSOLID =       9

                  PPP   BOX   SPH   RCC   REC   TRC   ELL   RAW   ARB   TEC   TOR   ARS
        NUMBER      0     0     0     0     1     2     0     1     1     3     0     0
        STORAGE     0     0     0     0    12    16     0    12    25    45     0     0

STORAGE FOR SOLID DATA                  110
STORAGE FOR SOLID POINTERS                8
TOTAL STORAGE FOR SOLIDS                118
```

The message "WARNING IN DESCRIPTION OF RAW SOLID NUMBER 1. VECTOR 11.0000 11.0000 11.0000 IS NOT PERPENDICULAR TO VECTOR 40.0000 0.0000 0.0000 WITHIN .5 DEGREES. ERROR IS 35.264 DEGREES" means that the angle between the two vectors which represent the leg and the depth of the right angled wedge (RAW) is equal to 90.0 - 35.264 or 54.736 rather than the required value of 90 ± .5 degrees. This warning message is printed whenever the right-angled vectors of a RAW, BOX or REC solid are more than .5 degrees from being perpendicular. If the error was only one degree, would it be necessary to change the input of the solid? An experienced user can determine the answer to this question on how the errant solid is used to model a component and the values of the overlap (TOL) and the gap tolerances (TOLLOS) specified on the Control card for the GIFT code. However, a large error such as 35.264 degrees indicates that either the parameters of the errant solid are incorrect or the solid type should be changed.

"RADIUS OF BASE. EQ. RADIUS OF TOP -- CYLINDER" means that the top radius of the TRC solid is equal to the base radius. If the input parameters for the TRC solid are correctly recorded, it is recommended but not required that the TRC solid be changed into an RCC solid to shorten the computer run time.

"RADIUS OF BASE. LT. RADIUS OF TOP - - CONE IS UPSIDE DOWN" means that the top radius of the TRC solid is larger than the base radius. The GIFT code assumes that the specified vertex is defined at the top of the cone instead of the base.

"AXES OF BASE. LT. AXES OF TOP -- CONE IS UPSIDE DOWN" means that the top ellipse of the TEC solid is larger than the base ellipse. If the ratio of the semi-major axis of the base to the semi-major axis of the top of the TEC is less than 1, the TEC cone is assumed to be upside down. The GIFT interchanges the base and the top of the cone. Although the interchanging performed by the GIFT code may be correct for the errant TRC or TEC solid, it is recommended that the input cards be corrected.

"RADIUS OF TOP, EQ. 0" means that the radius of the TRC is equal to zero. It may indicate that some data is missing from your input. However, if the data is correct, there is no need to change it.

"MAJOR AXIS. EQ. MINOR AXIS -- BASES ARE CIRCULAR" means that the base of the REC and TEC is a circle instead of an ellipse. If the solid is an REC and the input data is correct, it would be better to define the solid as an RCC because the computer run time and storage is less. If the solid is an TEC, the input data is correct and the height vector is perpendicular to the base, it is possible to define the solid as an TRC solid. The TRC solid would be preferred because the computer time and storage is less.

"HEIGHT VECTOR IS PERPENDICULAR TO BASE" means that the height vector of the TEC solid is perpendicular to its base. If the data is correct and this warning message stands alone, no change of solid type can be made.

"AXES of BASE, EQ. AXES of TOP -- CYLINDER" means that the length of the semi-major axis of the base of the TEC solid is equal to the length of the semi-major axis of the top and the length of the semi-minor axis of the base is equal to the length of the semi-minor axis of the top. If the height vector was also perpendicular to the base, the TEC solid could possibly be changed to an REC solid.

"WARNING IN DESCRIPTION OF ARB SOLID NUMBER 8 WARNING IN DESCRIPTION OF FACE 4 (2376) FACE IS PROCESSED AS (2376) FOUR POINTS NOT IN A PLANE DN = 3.369" means that the last vertex (6) of four vertices (2,3,7,6) which define the face of an ARB solid does not lie in the plane generated by the first three (2,3,7) vertices, the distance the fourth vertex is from the plane is the value of the variable DN (3.369). This warning is also printed for the 6th face (vertices 4,3,7,8) of solid "8 4ARB8" and is printed whenever the value of the variable DN is greater than 0.005 units. It is recommended that the vertex for errant ARBs be computed and recorded accurate enough to pass the 0.005 tolerance since it is difficult to determine values of DN that can be ignored and still have an accurate COM-GEOM description.

Table XV depicts the error messages for a Solid Table printed by GENI using the input listed in Table XIV.

"ERROR ITYPE...ARS" is printed when the input read by the GIFT code does not contain one of the solid symbols (RPP, BOX, SPH...ARS) the code required in columns 4 through 6 of the first card of each solid.

Other solid errors are prefixed by the following message: "ERROR IN DESCRIPTION OF (solid type: TOR, BOX, etc.) SOLID NUMBER (solid number)." The solid errors printed in Table XV may be interpreted as follows:

"RADIUS.EQ.O" means that a radius is equal to zero. In Table XV, this message is printed for the TOR solid. This message may also be printed for the SPH, REC or the TRC solids.

"R1.LT.R2" means that length of the radius which runs from the center of the TOR solid to the mid-point of the circular cross-section is less than the radius of the circular cross-section.

"MAGNITUDE OF VECTOR (integer number) IS 0" means that the length of the vector is zero. The number printed after the word "VECTOR" indicates the recorded position of the errant vector. In Table XV, "VECTOR 2" means that the second (width) of the three vectors of the

Table XIV. Sample Input to Generate Error Messages

```
SAMPLE INPUT TO GENERATE ERROR MESSAGES
                        9         1
1
1TOR        21.5          .      37.      1.       .        .
1             .        1.
2BOX       -74.       -35.      13.    148.       .        .
2             .         .        .       .        .      34.
3RPP       -75.        75.    -36.      36.     48.      12.
4ELL1         .         .        .       .        .        .
4             .
5ELL        20.          .      48.    -20.       .      48.
5            5.
6REC          .         .      24.       .        .      28.
6             .       2.5        .      5.        .        .
7TEC          .       7.5      49.     20.        .     -12.
7             .         .       3.       .       2.        .
7             .
8ARB4       21.5       -6.     33.5    21.5      6.     33.5
8           21.5          .        .    21.5      6.     33.5
9ARB5       75.       -36.      12.     75.     36.      12.
9           75.       -36.      48.     75.     36.      48.
9          100.          .      12.
  1         1       3XX   130R    2
  2         2
 -1

          1                        9          RESERVED AIR CODE
          2        100                        REGION 2
          3        200                        TOO MANY REGIONS IDENTIFIED
```

Table XV. GENI Output of a Solid Table Containing Error Message

```
ENTER GENI TO PROCESS GEOMETRY

TITLE - SAMPLE INPUT TO GENERATE ERROR MESSAGES

TARGET UNITS (  )

   NO. OF RECTANGULAR PARALLELEPIPEDS     0
   NO. OF SOLIDS                          9
   MAX NO. OF REGIONS                     1

NO RPP DATA

                                                    DESCRIPTION OF SOLIDS

ERROR  SOLID    1 ITYPE      DOES NOT MATCH AN ITY - RPP BOX SPH RCC REC TRC ELL RAW ARB TEC TOR ARS
      1   1  TOR             21.5000       0.0000      37.0000      1.0000      0.0000      0.0000
                              0.0000       1.0000

ERROR IN DESCRIPTION OF TOR     SOLID NUMBER     1
    RADIUS.EQ.0

ERROR IN DESCRIPTION OF TOR     SOLID NUMBER     1
    R1.LT.R2

      2   2  BOX           -74.0000     -35.0000      13.0000     148.0000      0.0000      0.0000
                              0.0000       0.0000       0.0000       0.0000      0.0000     34.0000

ERROR IN DESCRIPTION OF BOX     SOLID NUMBER     2
    MAGNITUDE OF VECTOR 2  IS 0

      3   3  RPP           -75.0000      75.0000     -36.0000      36.0000      48.0000      12.0000

ERROR IN DESCRIPTION OF RPP     3      XMIN.GE.XMAX


      4   4  ELL  V          0.0000       0.0000       0.0000       0.0000      0.0000      0.0000
                              0.0000

ERROR IN DESCRIPTION OF ELL     SOLID NUMBER     4
    MAGNITUDE OF VECTOR 1  IS 0

ERROR IN DESCRIPTION OF ELL     SOLID NUMBER     4
    MINOR AXIS.EQ.0

      5   5  ELL  F         20.0000       0.0000      48.0000     -20.0000      0.0000      48.0000
                             5.0000

ERROR IN DESCRIPTION OF ELL     SOLID NUMBER     5
    LENGTH OF MAJOR AXIS .LE. DISTANCE BETWEEN FOCI

      6   6  REC             0.0000       0.0000      24.0000       0.0000      0.0000      28.0000
```

Table XV. GENI Output of a Solid Table Containing Error Message (continued)

```
                              0.0000       2.5000       0.0000       5.0000       0.0000       0.0000

ERROR IN DESCRIPTION OF REC     SOLID NUMBER     6
    MAJOR AXIS.LT.MINOR AXIS

      7   7  TEC               0.0000       7.5000      49.0000      20.0000       0.0000     -12.0000
                               0.0000       0.0000       3.0000       0.0000       2.0000       0.0000
                               0.0000

ERROR IN DESCRIPTION OF TEC     SOLID NUMBER     7
    RATIO .EQ. 0

      8   8  ARB4              21.5000      -6.0000      33.5000      21.5000       6.0000      33.5000
                               21.5000       0.0000       0.0000      21.5000       6.0000      33.5000
                               1 2 3 0      4 1 2 0      4 2 3 0      4 3 1 0      0 0 0 0      0 0 0 0  GENERATED

ERROR IN DESCRIPTION OF ARB     SOLID NUMBER     8
    ERROR IN DESCRIPTION OF FACE 2       ( 4 1 2 0)      FACE IS PROCESSED AS ( 1 2 0 0)
        FACE IS A LINE

ERROR IN DESCRIPTION OF ARB     SOLID NUMBER     8
    ERROR IN DESCRIPTION OF FACE 3       ( 4 2 3 0)      FACE IS PROCESSED AS ( 2 3 0 0)
        FACE IS A LINE

ERROR IN DESCRIPTION OF ARB     SOLID NUMBER     8
    NUMBER OF POINTS .LT. 4     (= 3)

ERROR IN DESCRIPTION OF ARB     SOLID NUMBER     8
    NUMBER OF FACES  .LT. 4     (= 1)
                                 NUMBER OF POINTS 3      NUMBER OF FACES 1
      9   9  ARB5              75.0000     -36.0000      12.0000      75.0000      36.0000      12.0000
                               75.0000     -36.0000      48.0000      75.0000      36.0000      48.0000
                              100.0000       0.0000      12.0000
                               1 2 3 4      5 1 2 0      5 2 3 0      5 3 4 0      5 4 1 0      0 0 0 0  GENERATED
                                 NUMBER OF POINTS 5      NUMBER OF FACES 5

ERROR IN DESCRIPTION OF ARB     SOLID NUMBER     9
    ERROR IN DESCRIPTION OF FACE 3       ( 5 2 3 0)      FACE IS PROCESSED AS ( 2 3 5 0)
        ERROR IN SIDE DESCRIPTION
        REMAINING POINTS ( 1-4 0 0) DO NOT LIE ON THE SAME SIDE OF THE FACE

ERROR IN DESCRIPTION OF ARB     SOLID NUMBER     9
    ERROR IN DESCRIPTION OF FACE 5       ( 5 4 1 0)      FACE IS PROCESSED AS ( 1 4 5 0)
        ERROR IN SIDE DESCRIPTION
        REMAINING POINTS (-2 3 0 0) DO NOT LIE ON THE SAME SIDE OF THE FACE

LOCATION OF SOLID POINTERS      LBODY =          1
LOCATION OF SOLID DATA          LSOLID =        10

                  RPP   BOX   SPH   RCC   RFC   TRC   ELL   RAW   ARB   TEC   TOR   ARS
          NUMBER    1     1     0     0     1     0     2     0     2     1     1     0
          STORAGE   0     0     0     0     0     0     0     0    10     0     0     0

STORAGE FOR SOLID DATA                          10
STORAGE FOR SOLID POINTERS                       9
TOTAL STORAGE FOR SOLIDS                        19
```

BOX solid is errant. This error is printed for any solid which uses a vector to define its shape.

"ZMIN.GE.ZMAX means that the minimum Z (ZMIN) of the RPP solid is greater than or equal to the maximum Z (ZMAX). This error message is also printed if XMIN is greater than or equal to XMAX or YMIN is greater than or equal to YMAX.

"MINOR AXIS.EQ.O" means that the minor axis of the ELL solid is equal to zero.

"MAJOR AXIS.LT.MINOR AXIS" means that the length of the major axis of an errant REC or TEC solid is less than the length of the minor axis.

"RATIO.EQ.O means that the ratio of the semi-major axis of the base to the semi-major axis of the top of the TEC solid is equal to zero.

"ERROR IN DESCRIPTION OF FACE (face number)" identifies a face of of an errant REC or TEC solid is less than the length of the minor axis which describe the errant face: "FACE IS PROCESSED AS (vertices of errant face)." This message is printed for two faces of the ARB4 in Table XV: the second and third faces of ARB4 which are composed of vertices (4,1,2,0) and (4,2,3,0), respectively. The error indicated for both of these faces is "FACE IS A LINE" which means that all of the vertices defining the face lie on the same line, thus a plane or face is undefined. The "FACE IS PROCESSD AS (1 2 0 0)" and "FACE IS PROCESSED AS (2 3 0 0)" messages indicate that the fourth vertex is equal to another vertex because it does not appear in the "FACE IS PROCESSED AS" message. The second vertex is the only vertex common to both errant faces; thus, the values of the fourth vertex must be equal to the values of the second vertex. The error message printed for ARB5, faces 3 and 5 is another example. The "ERROR IN SIDE...DO NOT LIE ON THE SAME SIDE OF THE FACE" message states that the vertices of face 3 (5,2,3,0) define a plane which has the remaining vertices (1,-4,0,0) of ARB5 on opposite sides of the defined plane. Every vertex of a ARB solid which is not used to define the face (plane) should lie on the same side of the face.

Table XVI illustrates the error messages for a Region Table printed by GENI using the input listed in Table XIV. "ERROR IN DESCRIPTION OF REGION (the region number) IN FIELD (the field number)" identifies the errant region and the position (field) on the card defining the region where the error occurs. The error message in Table XVI states that the third descriptor (field) of region number 1 contains two errors:

(1) "ILLEGAL OPERATOR" ("XX"is printed where only the "OR" operator symbol or blank columns should be located.

(2) "SOLID NUMBER.GT.NSOLID" indicates that the solid number (13) is greater than the number of solids in the Solid Table.

Table XVI. GENI Output of a Region Table Containing Error Messages

```
                                        REGION COMBINATION DATA
   1    1          1          3  XX    13  OR     2          0          0          0          0          0

ERROR IN DESCRIPTION OF REGION     1  IN FIELD  3
    ILLEGAL OPERATOR


ERROR IN DESCRIPTION OF REGION     1  IN FIELD  3
    SOLID NUMBER.GT.NSOLID


ERROR IN DESCRIPTION OF REGION     1  NEED (OR) WITH FIRST DESCRIPTOR

   2    2          2          0          0          0          0          0          0          0          0

ERROR  NUMBER OF REGIONS.GT.NPMAX


LOCATION OF REGION POINTERS      LREGD  =       103
LOCATION OF REGION LIST          LREGL  =       104

NUMBER OF DESCRIPTORS                            5
STORAGE FOR REGION POINTERS                      1
TOTAL STORAGE FOR REGIONS                        6


TERMINATION ON GEOMETRY INPUT ERROR
IERR=        20
```

"NEED (OR) WITH FIRST DESCRIPTOR" indicates that an "OR" is used in the description of the region; however, the required "OR" is used in Columns 7 and 8 was not recorded.

"ERROR NUMBER OF REGIONS.GT.NRMAX" indicates that number of regions specified on the Target Specification card (Columns 21 to 30) is less than the number of regions contained in the Region Table.

The Region RPP Equivalent Table has one warning and one error message. "**DIAGNOSTIC**REGION (region number) IS NULL REGION" is a warning message indicating that a region has no volume. This can be desirable especially when a one-to-one correspondence between the solid and region numbers is maintained. This warning message changes to "**DIAGNOSTIC**THE FOLLOWING REGIONS ARE NULL: followed by a list of null regions when the No Print Option (Column 10) is specified on the Control card. The error message "REGION (region number).GT.MAX REGION (maximum number of Regions)" is printed whenever the region number in Columns 1-10 of Region RPP Equivalent Table is larger than the maximum number of regions specified in Columns 21-30 of the Target Specification card.

Table XVII contains the warning and error messages that are generated by GENI for the Region Identification Table listed in Table XIV.

"ERROR IN IDENTIFICATION OF REGION (region number) ILLEGAL TO INPUT SPACE CODE (number)" means that the air space code used is the same as the Signal Code for end of components along a ray (columns 61-65) specified on the Control card.

"WARNING IN IDENTIFICATION TABLE REGION (region number).GT.MAXIMUM NUMBER OF REGIONS (maximum number of regions)" means that a specified region number is greater than the number of regions described in the Region Table. This message is usually printed when fewer regions were described in the Region Table than was intended.

As previously stated, the processed COM-GEOM data is stored in a large common equivalenced array in the GIFT array code called the MASTER-ASTER array. Stated in BRL Report No. 1802, the size of MASTER-ASTER is stored in a variable called NDQ. Also stated in BRL Report No. 1802, good estimation of the amount of storage required for a COM-GEOM description is 45 words of storage for each solid described. Table XVIII contains the formula to compute an accurate value for the MASTER-ASTER array and NDQ. If enough storage is not allowed at any particular point in the processing of the COM-GEOM description by GENI, an error message will be printed and normally execution of the code will be terminated.

"NO ROOM FOR SOLID DATA. LSOLID.GE.LRPPEQ NDQ (the value of LSOLID, the value of LRPPEQ, and the value of NDQ)" is printed if the variable NDQ is less than or equal to seven times the number of solids plus one.

Table XVII . GENI Output of a Region Identification Containing Warning and Error Messages

```
IDENTIFICATION TABLE
REGION        ITEM        SPACE        DESCRIPTION

     1           0            9        RESERVED AIR CODE

ERROR IN IDENTIFICATION OF REGION        1
     ILLEGAL TO INPUT SPACE CODE  9

     2         100            0        REGION 2
     3         200            0        TOO MANY REGIONS IDENTIFIED

WARNING IN IDENTIFICATION TABLE     REGION     3 .GT. MAXIMUM NUMBER OF REGIONS     2

LOCATION OF IDENT TABLE          LINFO  =          41
STORAGE FOR IDENT TABLE                            2

LOCATION ALPHA REG DESCRIPTION  LDES    =          46
STORAGE FOR ALPHA REGION DESCRIPTION               8
```

Table XVIII. Formula to Compute Storage Requirement for MASTER-ASTER Array

MASTER-ASTER Storage = 4 * number of Solids + 7 * number of RCCs
(* = times) + 12 * number of RECs + 8 * number of TRCs
+ 15 * number of TECs + 4 * number of SPHs
+ 11 * number of TORs +12 * number of ELLs
+ 6 * number of RPPs +15 * number of BOXs
+ 12 * number of RAWs + ARB storage
+ non-convex ARS storage + convex ARS storage
+ 14 * number of Regions
+ number of Region Descriptors
+ 6
+ alphaumeric storage

$$\text{ARB Storage} = \sum_{1}^{\text{number of ARBs}} 4* \text{number of faces per ARB} + 1$$

$$\text{Non-Convex ARS Storage} = \sum_{1}^{\text{number of non-convex ARSs}} 88 + 4*(L+2*N*(M-1)$$

where L = number of points read directly

M = number of curves

N = number of points per curve

$$\text{Convex ARS Storage} = \sum_{1}^{\text{number of convex ARSs}} 4* \text{number of non-degenerate faces per ARS} + 1$$

Number of Region Descriptors is the number of non-zero numbers in columns 7 through 69 of Region Table.

Alphanumeric storage (optional) = N * number of Regions.

N = 4 for CDC computers, 7 for UNIVAC computers, and 10 for IBM computers.

"NO MORE ROOM FOR SOLID DATA
LOCDA = (location) LRPPEQ = (location) NDQ = (value of NDQ)" is printed whenever the variable LOCDA is greater than or equal to the variable LRPPEQ. LOCDA is the location in the MASTER-ASTER array of the solid currently being stored. LRPPEQ is the location in the MASTER-ASTER array of the temporary Solid RPP Equivalent Table. The storage required for the Solid RPP Equivalent Table is released after the Region RPP Equivalent Table is computed. If GENI has processed over three quarters of the Solid Table at this point, doubling the size of the MASTER-ASTER array and the variable NDQ is a good rule of thumb for correcting this error.

"NO MORE ROOM FOR REGION DATA
LOC = (location) LRPPEQ - (location) NDQ - (value of NDQ)" is printed when there is not enough room in the MASTER-ASTER array to store the region descriptors. LOC is the location in the MASTER-ASTER array of region descriptor currently being stored. The number of region descriptors is the count of all the non-zero numbers in columns 9 through 69 of the Region Table. Increasing the size of the MASTER-ASTER array and NDQ by fourteen times the number of regions plus the number of descriptors remaining to be processed should correct this error.

"NO ROOM FOR IDENTIFICATION TABLE
LIRFO (location) NRMAX (number of regions) NDQ (value of NDQ)" is printed when there is not enough room in the MASTER-ASTER array for the Region Identification Table. LIRFO is the location of the starting point of the storage for the Region Identification Table in the MASTER-ASTER array. Increasing the size of the MASTER-ASTER array and the variable NDQ to equal the value of the number printed next to "LIRFO" plus the number printed next to "NRMAX" in the error message plus three times the number of solids will correct this error.

"NOT ENUF STORAGE TO PRINT IDENTIFICATION TABLE BY ITEM - OPTION IGNORED
LITEM (location) LAST (location) NDQ (value of NDQ)" is printed whenever the Ordered Identification Table Option is specified on the Control card (column 7) and there is not enough room in the MASTER-ASTER array to store the region number - space code - item code packed word and the alphanumeric description for each region. The number next to "LAST" in the warning message is the minimum size required for the MASTER-ASTER array and the variable NDQ in order to perform this option. The GIFT code does not terminate execution because of this error.

"NO ROOM FOR WORKING STORAGE
LEGEOM (location) NDQ (location)" is printed when not enough room is made available in the MASTER-ASTER array for temporary storage which is used while the GIFT code is tracing a ray. The number next to LEGEOM is the minimum size required for the MASTER-ASTER array and the variable NDQ in order to correct this error.

"NO ROOM TO STORE ALPHA REGION DESCRIPTION" is printed when there is not enough room in the MASTER-ASTER array to store the alphanumeric description of the regions in the Region Identification Table. If there is not enough room in the MASTER-ASTER array, the GIFT code does not terminate execution but the columns in the output which would contain the alphanumeric description of a region will be left blank. The alphanumeric description of a region can be particularly helpful to an analyst when he is debugging a COM-GEOM description. Increasing the size of the MASTER-ASTER array and the variable NDQ to equal the number printed next to the value "LEGEOM" printed in the Storage Summary Table plus N times the number of regions where N=4 for the CDC computers, N=7 for the UNIVAC computers, and N=10 for the IBM computers will ensure that the alphanumeric description of the regions is stored.

E. GIFT Basics

To understand the output options of the GIFT code, a discussion of the Azimuth and Elevation Angle Reference System and the grid is presented. The x, y, and z cartesian coordinate system defined in BRL Report 1802 is used to reference the spacial location of the parameters recorded in the COM-GEOM description, an azimuth and elevation angle is used by the output options of the GIFT code to specify a view plane (attack aspect) of a target. Figure 4 displays the relationship between the Azimuth and Elevation Angle Reference System associated with the output options and the x, y and z coordinates associated with target description data.

In Figure 4, the "TOP VIEW" of the simplified tank illustrates different angular values of the azimuth angle. The dashed circumscribed circle around the "TOP VIEW" may be interpreted as the top view of the path that an individual would make on the ground as he walked around the tank. The point R is the point where the x-axis intersects the circumscribed circle and the point 0 is the origin of the x, y and z coordinate system of the COM-GEOM description. An individual at point R looking toward point 0 is at the reference position where the azimuth angle is zero degrees. The angle formed at the points R, 0 and P is 45 degress; therefore, an individual standing at point "P" looking toward 0 is at the position where the azimuth angle is 45 degrees. The azimuth angle then varies from 0 to 360 degrees as an individual moves from point R counterclockwise around the tank on the dashed line.

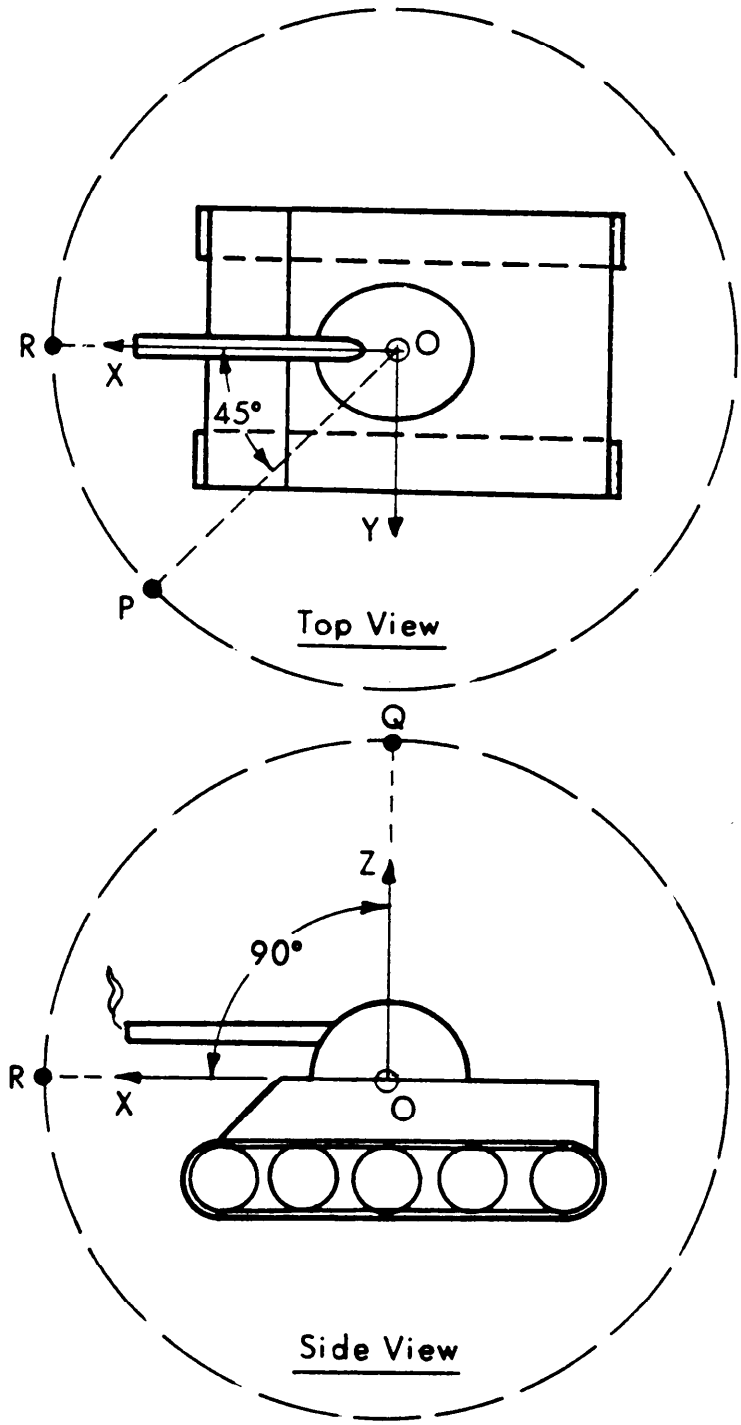


Figure 4. An Illustration of Azimuth and Elevation Angles

The "SIDE VIEW" of Figure 4 of the tank is used to illustrate the different angular values of the elevation angle. The points 0 and R are in the same position as in the "TOP VIEW" of Figure 4. The view from point R towards point 0 is then the view where the elevation angle is zero. The angle between points R, 0 and Q is 90 degrees; therefore, the elevation angle of the view from point Q towards point 0 of the tank is 90 degrees. The elevation angle varies from 0 to 360 degrees as the point of view circles the tank from point R in a clockwise direction. The Azimuth and Elevation Angle Reference System allows viewing the target from any desired aspect.

A COM-GEOM description is enclosed in a rectangular parallelepiped (RPP) whose sides are parallel to the three coordinate axes. The smallest XMIN of the Region RPP Table becomes the XMIN of the enclosing RPP, the smallest YMIN becomes YMIN of the enclosing RPP, and the smallest ZMIN becomes the ZMIN of the enclosing RPP. Likewise, the largest XMAX of the Region RPP Table becomes the XMAX of the enclosing RPP, etc.

A view plane containing the origin of the COM-GEOM description is generated for a given azimuth and elevation angle. A line which extends through the origin of the COM-GEOM description and the point from which the target is being viewed is perpendicular to this view plane. For example, the y-z plane is the view plane when the azimuth and elevation angle is zero. The enclosing RPP is then projected onto the view plane forming a two-dimensional shape which is then enclosed by a rectangle called a grid. A grid is divided into equal squares or rectangles called grid cells. These grid cells are situated so that the origin of the COM-GEOM description is located in the center of one of the grid cells. Figure 5 depicts a grid and its parameters.

A grid has a horizontal (H) length and a vertical (V) length. A grid cell also has a horizontal and vertical length which is called cell size. Figure 5 has three equal horizontal grid cell lengths and five equal vertical grid cell lengths.

Each grid cell can be identified by its matrix position. The grid cell containing the origin of the COM-GEOM description is identified as (0,0) grid cell. The grid cells are numbered positive in the positive vertical direction and positive towards the right in the horizontal direction. Therefore, the top-right grid cell in Figure 5 is identified as the (1,2) grid cell. Similarly, the remaining grid cells can be uniquely identified by their matrix indices.

A ray (line) is traced through the target perpendicular to the view plane in each grid cell. The location of the ray within the grid cell may be either the center of the cell or a "random" location. To determine the random location of the grid cell, the grid cell is further divided into a ten by ten cell matrix or 100 cells as depicted in Figure 6. These "little" cells are numbered from zero to nine in

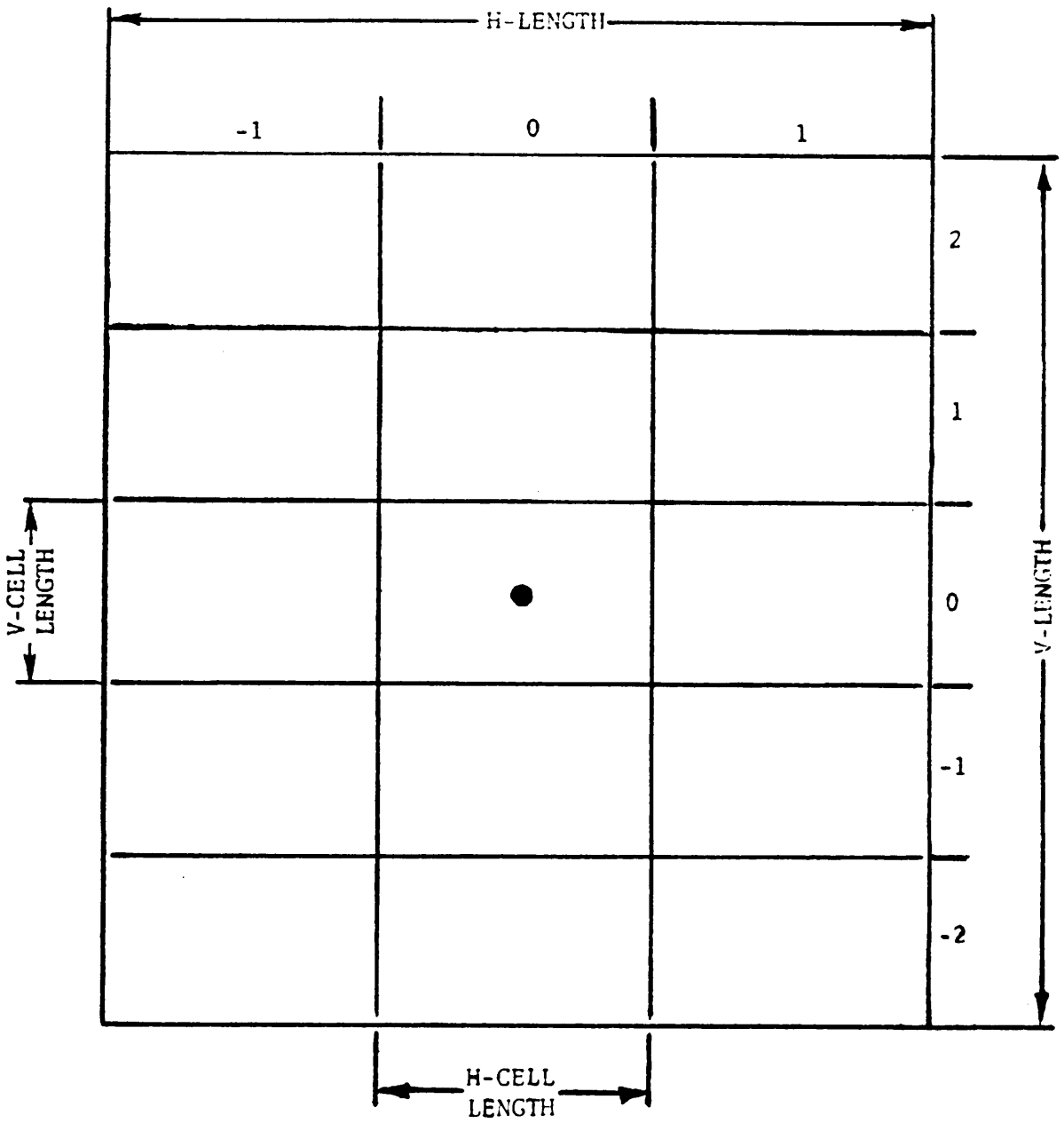


Figure 5. A Grid and Its Parameters

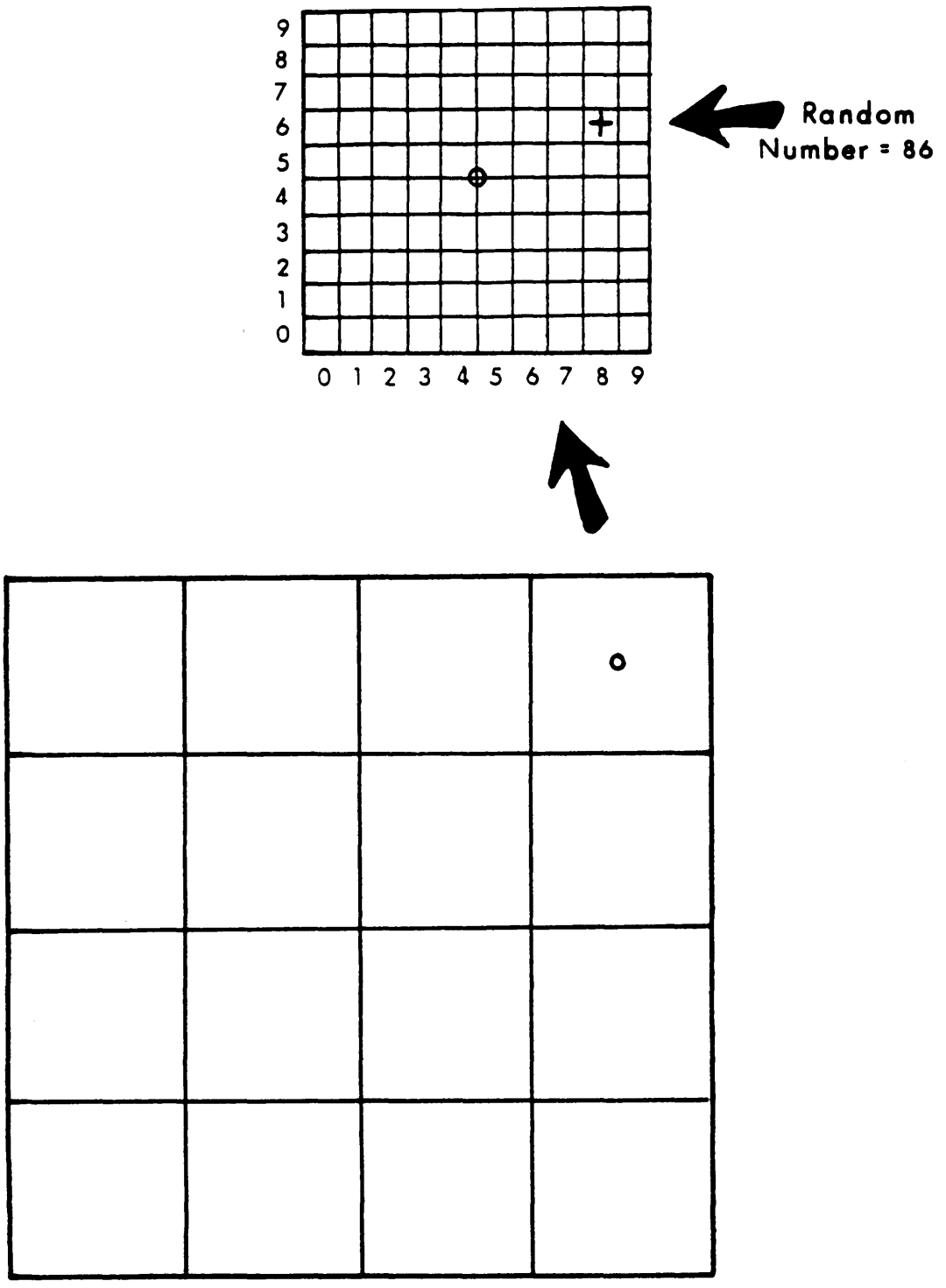


Figure 6. Locating "Random" Point in Grid Cell

the horizontal direction from left to right and in the vertical direction from bottom to top. One of these "little" cells is picked at random and the ray is traced through its center.

The GIFT code uses a grid to generate the data for most of the output options. The rays that are generated through the grid cells contain starting points in a plane which is parallel to the view plane and lies completely exterior to the COM-GEOM description. The distances from the starting point of the ray to the points of intersection of a region with the ray is computed. This is compared with the distances to the points of intersection of other regions with the ray. Whenever two or more regions have entrance and exit distances that overlap, an error message is printed by the GIFT code. Table XIX is an example of an error message.

The error message is printed so that an analyst can determine why the overlap occurred. Table XIX is divided into three sections labeled A, B and C. Section A describes the ray and regions intersected by the ray in a general form. Section B presents the two or more regions that overlap. Section C describes the overlapping regions in more detail.

Section A contains the x, y and z coordinates of the "STARTING POINT OF THE RAY," the "DIRECTION COSINES OF RAY" (a normalized vector with the same direction as the ray) and a subsection which contains a list of all regions that the ray intersected (ray history). This ray history lists from top to bottom the regions in the order they are intersected as the ray proceeds from the starting point. The second column labeled "ITEM" is the item code number for the region listed in column one. If the item code is zero, it is likely that the region is an air space. The third column labeled "DIST IN" is the distance along the ray from the starting point of the ray to the point where the ray enters the region. If the value of "DIST IN" is extremely large such as 1×10^{35} (may be printed "***..."), the starting point of the ray is inside the region. The column labeled "DIST OUT" is the distance along the ray from the starting point to the point where the ray exits the region. The column labeled "LOS" is the distance along the ray from the point where the ray enters the region to the point where it exits the region. The columns labeled "SOL SURF" are the solid and surface numbers of the solids at the entrance and exit points of the intersection of the ray and the region. Table XX identifies the surfaces of solids by their surface code numbers. If a surface code number is negative, the solid is being exited by the ray at the entrance or exit points. The columns labeled "X IN...X OUT" are the x, y and z coordinates of the entrance and exit points of the region.

The information in the section marked B in Table XIX is similar to the information printed in the ray history portion marked A. The total ray history is edited to pinpoint the regions that overlap.

Table XIX. Example of an Error Message Printed When Two or More Regions Overlap

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * ERROR   1 * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

A

```
STARTING POINT OF RAY        20.00000      0.00000     51.15000
DIRECTION COSINES OF RAY     -1.00000      0.00000      0.00000

NUMBER OF INTERSECTIONS OF RAY AND ALL REGIONS IS     9
 REGION  ITEM     DIST  IN     DIST OUT      LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
     22   401*************    3.10588**********      0     0    23     3**********    0.0000   51.1500   16.8941   0.0000   51.1500
     19     J      3.10588     4.43057     1.3247    23     3    21     2   16.8941    0.0000   51.1500   15.5694   0.0000   51.1500
     23     0      3.10588     4.43057     1.3247    23     3    21     2   16.8941    0.0000   51.1500   15.5694   0.0000   51.1500
     21   400      4.43057    10.09117     5.6606    21     2    21    -1   15.5694    0.0000   51.1500    9.9088   0.0000   51.1500
     22   401      8.09601     9.00662      .9106    23    -3    22    -1   11.9040    0.0000   51.1500   10.9934   0.0000   51.1500
     19     C     10.09117    15.00000     4.9088    21    -1    13     3    9.9088    0.0000   51.1500    5.0000   0.0000   51.1500
     13  3031     15.00000    25.00000    10.0000    13     3    13    -3    5.0000    0.0000   51.1500   -5.0000   0.0000   51.1500
     19     G     25.00000    43.38461    18.3846    13    -3    19    -1   -5.0000    0.0000   51.1500  -23.3846   0.0000   51.1500
      5   101     43.38461    44.44253     1.0579    19    -1     5    -1  -23.3846    0.0000   51.1500  -24.4425   0.0000   51.1500
```

B

```
ERROR - FOLLOWING REGIONS OVERLAP
 REGION     DIST  IN     DIST OUT      LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
     19     3.10588     4.43057     1.3247    23     3    21     2   16.8941    0.0000   51.1500   15.5694   0.0000   51.1500
     23     3.10588     4.43057     1.3247    23     3    21     2   16.8941    0.0000   51.1500   15.5694   0.0000   51.1500

ERROR - FOLLOWING REGIONS OVERLAP
 REGION     DIST  IN     DIST OUT      LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
     21     4.43057    10.09117     5.6606    21     2    21    -1   15.5694    0.0000   51.1500    9.9088   0.0000   51.1500
     22     8.09601     9.00662      .9106    23    -3    22    -1   11.9040    0.0000   51.1500   10.9934   0.0000   51.1500
```

C

```
REGION    19    ITEM      0    SPACE   2    DESCRIPTION   INSIDE AIR (BUBBLE)                                ELL1
        OP SOLID TYP       RIN          ROUT         LOS     SURFI SURFO     X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
         +    19 ELL ************    43.38461**********      0     1**********    0.0000   51.1500  -23.3846   0.0000   51.1500

NUMBER OF INTERSECTIONS OF RAY AND REGION   19 IS   1
   REGION ITEM   DIST  IN     DIST OUT      LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
       19     0************    43.38461**********      0     0    19    -1**********    0.0000   51.1500  -23.3846   0.0000   51.1500

REGION    23    ITEM      0    SPACE   1    DESCRIPTION   GUN AIR
        OP SOLID TYP       RIN          ROUT         LOS     SURFI SURFO     X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
         +    23 RCC       3.10588     8.09601     4.9901     3     3   16.8941    0.0000   51.1500   11.9040   0.0000   51.1500

NUMBER OF INTERSECTIONS OF RAY AND REGION   23 IS   1
   REGION ITEM   DIST  IN     DIST OUT      LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
       23     0    3.10588     8.09601     4.9901    23     3    23    -3   16.8941    0.0000   51.1500   11.9040   0.0000   51.1500

REGION    21    ITEM    400    SPACE   0    DESCRIPTION   GUN RECEIVER
        OP SOLID TYP       RIN          ROUT         LOS     SURFI SURFO     X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
         +    21 BOX       4.43057    10.09117     5.6606     2     1   15.5694    0.0000   51.1500    9.9088   0.0000   51.1500

NUMBER OF INTERSECTIONS OF RAY AND REGION   21 IS   1
   REGION ITEM   DIST  IN     DIST OUT      LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
       21   400    4.43057    10.09117     5.6606    21     2    21    -1   15.5694    0.0000   51.1500    9.9088   0.0000   51.1500

REGION    22    ITEM    401    SPACE   0    DESCRIPTION   GUN BARREL
        OP SOLID TYP       RIN          ROUT         LOS     SURFI SURFO     X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
         +    22 RCC ************    9.00662**********      0     1**********    0.0000   51.1500   10.9934   0.0000   51.1500
         -    23 RCC       3.10588     8.09601     4.9901     3     3   16.8941    0.0000   51.1500   11.9040   0.0000   51.1500

NUMBER OF INTERSECTIONS OF RAY AND REGION   22 IS   2
   REGION ITEM   DIST  IN     DIST OUT      LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
       22   401************    3.10588**********      0     0    23     3**********    0.0000   51.1500   16.8941   0.0000   51.1500
       22   401    8.09601     9.00662      .9106    23    -3    22    -1   11.9040    0.0000   51.1500   10.9934   0.0000   51.1500
```

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * END ERROR   1 * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

Table XX. Identify Surfaces of Solids by Their Code Numbers

Solid Type	Surfaces	Code Numbers
RCC, REC, TRC, TEC	base	1
	top	2
	side	3
TOR, ELL, SPH	(only one)	1
RPP	XMIN	1
	XMAX	2
	YMIN	3
	YMAX	4
	ZMIN	5
	ZMAX	6
ARB~~b~~	(Surface code numbers correspond to the order in which faces are described)	
ARB8	1,2,3,4	1
Faces having vertices	5,6,7,8	2
	1,5,8,4	3
	2,3,7,6	4
	1,2,6,5	5
	4,3,7,8	6
ARB7	1,2,3,4	1
Faces having vertices	5,6,7	2
	1,4,5	3
	2,3,7,6	4
	1,2,6,5	5
	4,3,7,5	6
ARB6	1,2,3,4	1
Faces having vertices	2,3,6,5	2
	1,5,6,4	3
	5,1,2	4
	6,3,4	5

Table XX. Identify Surfaces of Solids by Their Code Numbers (continued)

Solid Type		Surfaces	Code Numbers
ARB5		1,2,3,4	1
	Faces	5,1,2	2
	having	5,2,3	3
	vertices	5,3,4	4
		5,4,1	5
ARB4		1,2,3	1
	Faces	4,1,2	2
	having	4,2,3	3
	vertices	4,3,1	4
BOX	Surface containing	1	1
	vertex and normal	2	3
	to vector number	3	5
	Surface opposite	1	2
	vertex and normal	2	4
	to vector number	3	6
RAW	Surface containing	1	1
	vertex and normal	2	3
	to vector number	3	5
	Surface opposite vertex and normal to vector number	3	6
	Slant surface		2

ARS Given a surface number P of an ARS with M curves and N points per curve:

The curve in which a vertice of the surface is located = $1 + [(P + I - 1)/2N] + \text{Mod}(P + I - 1, 2)$

The point in the curve = $1 + \text{Mod}[(P + I - 1)/2, 2]$

where I = 1, 2, 3 and Mod is equal to the remainder of the first argument when it is divided by the second argument.

Section C describes the overlapping regions in more detail. Each region description consists of two parts, a part which supplies specific information about the ray and the region's solids and a part which gives a summary of the ray and region interaction. The first part contains an identification line ("REGION 19...ELL1" is the identification line for Region 19 in Table XIX) which supplies the item code and the alpha-numeric description of the region. The GIFT code will print an error message if the regions that overlap have item codes or different air space codes. Regions 21 and 22 in Table XIX are two overlapping regions which have item codes. Regions 19 and 23 are two overlapping regions which have different air space codes. The lines that follow the identification line define the solids which are intersected by the ray that are used to describe the region. The column under "OP" is the operation (+,-,"OR") performed in the Region Table as described in BRL Report 1802. The column under "TYPE" is the type of solid. The remainder of the information printed is similar to the information previously discussed. The portion of the total ray history which the region contributes to is the second part of each overlapping region description. It also contains information previously discussed.

III. OUTPUT OPTIONS

The output options such as AREA, CHECK, etc. may be categorized by the general type of computing they perform. Each of the output options has parameters which can be adjusted to the particular job performed. The set of cards for a particular output option can be a subset of cards containing a number of output options. An output option is randomly accessed by the GIFT code and can be referenced more than once in the same card deck. To gain access to an output option, the GIFT code requires a Declaration card which contains a left adjusted code word such as AREA, CHECK, PICTUR, etc. in Columns 1 through 6. Table XXI contains the code for the output options and a brief description of the tasks they perform.

A. AREA Option

The AREA option computes the presented area of the visible exterior regions of the COM-GEOM description from any set of azimuth and elevation angles. The centroid of the presented area and the centroid of the perimeter of the COM-GEOM description are also computed. A pictorial representation of the grid cells hit, missed or on the perimeter can also be plotted on the printer or plotter or both. Figures 7 through 9 describe the input cards for the AREA option.

If the error message "*** ERROR IN AREA **** NUMBER OF REGIONS (number of regions) EXCEEDS SIZE OF ARRAY AREA AND ARRAY ITEM (size of arrays)," the arrays called AREAS and ITEM and the variable MAXREG have to be changed to equal or exceed the number of regions in the COM-GEOM description.

Table XXI. Description of GIFT Output Options

Code Word	Description
AREA	Computes presented area of regions.
BRANDX	A user defined subroutine.
CHECK	Checks regions for overlap errors and plots silhouettes of regions on the printer.
GRID	Produces parallel ray data used for vulnerability analysis.
MOMENT	Computes weights and the moment of inertia about the center of gravity.
PICTUR	Generates a line drawing of the COM-GEOM data with hidden lines removed.
PLTRPP	Printer plots region RPP Equivalents.
RIP	Produces burst point ray data for vulnerability analysis.
TESTG	Tracks a ray and prints a detailed history.
VOLUME	Computes volumes and center points of regions.
XSECT	Plots intersection of COM-GEOM description with a plane.

1-10	11-20	21	22-23	24-25	26-27	29-80
NVIEW	MAXERR	TGTRPP	TGTUN	AREAUN	CENTUN	

FORMAT (2I10,L1,3A2)

NVIEW - Specify number of views for the AREA Option

MAXERR - Specify the maximum number of overlap errors that will be tolerated for each view

TGTRPP - "T" Read a Target Enclosing RPP card
"F" Don't read a Target Enclosing RPP card

(Default = "F")

(Allowable codes for following options are:

IN = inches, FT = feet, CM = centimeters,

M = meters, MM = millimeters)

TGTUN - Specify the code to denote units in which the COM-GEOM description is described. (Default = IN)

AREAUN - Specify the code to denote units in which areas are to be printed (Default = IN)

CENTUN - Specify the code to denote units in which centroids are to be printed (Default = IN)

Figure 7. Control Card for AREA Option

1-10	11-20	21-30	31-40	41-50	51-60	61-80
XMIN	XMAX	YMIN	YMAX	ZMIN	ZMAX	

FORMAT (6F10.01)

The minimum (min) and the maximum (max) values of the x, y and z coordinates which bound the rectangular parallelpiped that encloses the COM-GEOM description. (Default is the computed Enclosing RPP located at LENRPP in ASTER.)

Figure 8. Target Enclosing RPP Card for AREA Option (Optional, read only if TGTRPP = "T" on Control Card for AREA)

1-10	11-20	21-30	31	32	33	34	35	36-37	38	39	40	41-80
A	E	CELSIZ	PLOT	PLPR	CENTER	GRID	VARSIZ		SYMMIS	SYMHIT	SYMPER	

FORMAT (3F10.0,5L1,2X,3A1)

A - Specify the Azimuth Angle in degrees

E - Specify the Elevation Angle in degrees

CELSIZ - Specify the grid cell size (Default = 4.0)

PLOT - "T" Plot picture of hit, missed and perimeter grid cells on plotter

PLPR - "T" Plot picture of hit, missed and perimeter grid cells on printer

CENTER - "T" Rays are tracked through the center of the grid cells in the viewing plane

- "F" Rays are tracked through a random point in the grid cells in the viewing plane

GRID - "T" and PLOT = "T" Draw grid squares on plotter

VARSIZ - "T" and PLPR = "T" Distort the vertical length of the grid cell to present a true picture of the COM-GEOM description on printer. This option normally sets vertical length of the grid cell to be 10/6 times CELSIZ

SYMMIS - PLPR = "T" Symbol to print for missed grid cell (Default = blank)

SYMHIT - PLPR = "T" Symbol to print for hit grid cell (Default = "1")

SYMPER - PLPR = "T" Symbol to print for perimeter grid cell (Default = "2")

Figure 9. View Card for Area Option

Table XXII is an example of the printout of the AREA option using the input of Figure 10 and the sample target COM-GEOM description of Table I. The portion of Table XXII labeled A with heading "TARGET PARAMETER..." describes the enclosing RPP of the target. The portion of the labeled A section with the heading "VIEW PLANE" describes the grid of the target for the selected azimuth and elevation angles. The "HORIZONTAL LENGTH" defines size of a box which would contain the enclosing RPP of the target whose horizontal and vertical sides would be parallel to the view plane. The "BACK OFF DISTANCE" is the distance the starting points of the rays are from the view plane which contains the origin of the COM-GEOM description. The "CENTER" is the horizontal (H) and vertical (V) coordinates of the center of the grid. The "HORIZONTAL RANGE" and "VERTICAL RANGE" are the H and V minimums and maximums of the grid which have been extended to accomodate the grid cell size.

The scale that is automatically generated by the GIFT code for any plotter plots is eight times the grid cell size. If a different scale is desired, the variable CELL in subroutine AREA has to be changed.

The rectangle labeled B in Table XXII is a pictorial representation of the grid. "M" represents those grid cells in which the ray missed the target. "H" represents those grid cells in which the ray hit the target. "P" represents those ray hit the target which also lie on the border (perimeter) between those hit and those missed.

The portion of Table XXII labeled C contains the presented area for each visible exterior region. For example, the presented area for Region 3 is 2864.5104 square centimeters. The second portion is a table of presented areas of each visible exterior region sorted by identification code. Those regions with zero presented areas cannot be seen from this view. The portion labeled D in Table XXII displays the centroid of the presented areas in Table XXII as "H=.0370 meters and V = .7544 meters."

The portions labeled E and F in Table XXII displays the same azimuth and elevation angles as in the first view but the option to distort grid cells to give a true picture of the COM-GEOM description on printer was chosen. The vertical cell size was changed to 3.333 in the section labeled E by the GIFT code because the printer is set to six vertical lines per inch. The default printer characters were chosen for the pictorial representation of the grid in the section labeled F.

An example of the plotter pictorial representation of the AREA option is displayed in Figure 11. The grid cell size does not have to be distorted to display a true picture of the COM-GEOM discrption on the plotter.

Table XXII. Sample Output for AREA Option
(Compressed for Display)

```
ENTER AREA

AZIMUTH                    90.000
ELEVATION                   0.000

TARGET PARAMETERS            X          Y          Z
  MINIMUM                 -100.000    -36.000      .000
  MAXIMUM                  100.000     36.000    63.000
  CENTER                     0.000      0.000    31.500
  DIMENSIONS               200.000     72.000    63.000

VIEW PLANE
  HORIZONTAL LENGTH        200.000
  VERTICAL LENGTH           63.000
  DEPTH                     72.000
  BACK OFF DISTANCE         56.000
  CENTER                     0.000     31.500
  HORZ CELL SIZE             2.000
  VERT CELL SIZE             2.000
  HORIZONTAL RANGE        -100.000    100.000
  VERTICAL RANGE             0.000     64.000

NUMBER HORZ CELLS              101
NUMBER VERT CELLS               33
NUMBER OF CELLS               3333

FIRST SEED FOR RANDOM NUMBER GENERATOR

OPTION SET TO CHOOSE RANDOM POINT IN CELL

OPTION SET TO PLOT ON CALCOMP
  HORIZONTAL PAGE        12.625
  VERTICAL PAGE           4.125
  SCALE IS 1.0 IN. =   16.00 IN.

OPTION SET TO PLOT ON PRINTER
```

A

Table XXII. Sample Output for AREA Option (continued)
(Compressed for Display)

AZIMUTH 90.0 ELEVATION 0.0

HORIZONTAL CELL SIZE 2.000 IN.
VERTICAL CELL SIZE 2.000 IN.

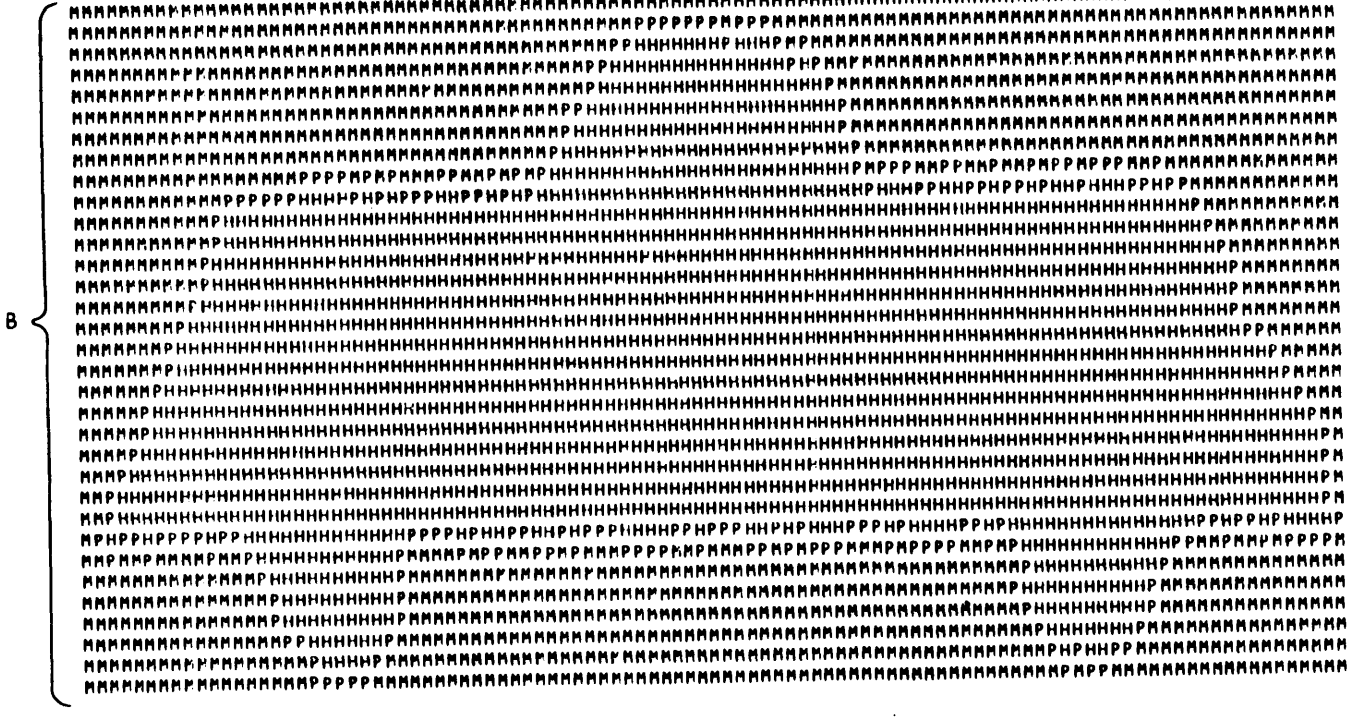


Table XXII. Sample Output for AREA Option (continued)
(Compressed for Display)

```
AZIMUTH   90.0    ELEVATION    0.0

HORIZONTAL CELL SIZE IS  2.000 IN.
VERTICAL CELL SIZE IS    2.000 IN.
AREAS IN SQ.CM.

NUMBER OF CELLS HIT     1866.

REGION  ITEM  PRESENTED AREA     REGION  ITEM  PRESENTED AREA     REGION  ITEM  PRESENTED AREA     REGION  ITEM  PRESENTED AREA
    1    40  0.                     2  1041  0.                     3   100   .28645104E+04         4   100   .35612832E+04
    5   101   .39225728E+04         6   100   .31767679E+05         7   651  0.                     8   652   .29935424E+04
    9   653  0.                    10   654   .30451552E+04        11  2701  0.                    12   111  0.
   13  3031  0.                    14  3031  0.                    15  3031  0.                    16  3031  0.
   17  3031  0.                    18  3031  0.                    19     0  0.                    20     0  0.

TOTAL AREA      .48154742E+05

        ITEM  PRESENTED AREA             ITEM  PRESENTED AREA             ITEM  PRESENTED AREA             ITEM  PRESENTED AREA
          0  0.                           0  0.                          40  0.                          100   .31767678E+05
         100   .28645104E+04             100   .35612832E+04             101   .39225728E+04             111  0.
         651  0.                         652   .29935424E+04             653  0.                         654   .30451552E+04
        1041  0.                        2701  0.                        3031  0.                        3031  0.
        3031  0.                        3031  0.                        3031  0.                        3031  0.
```

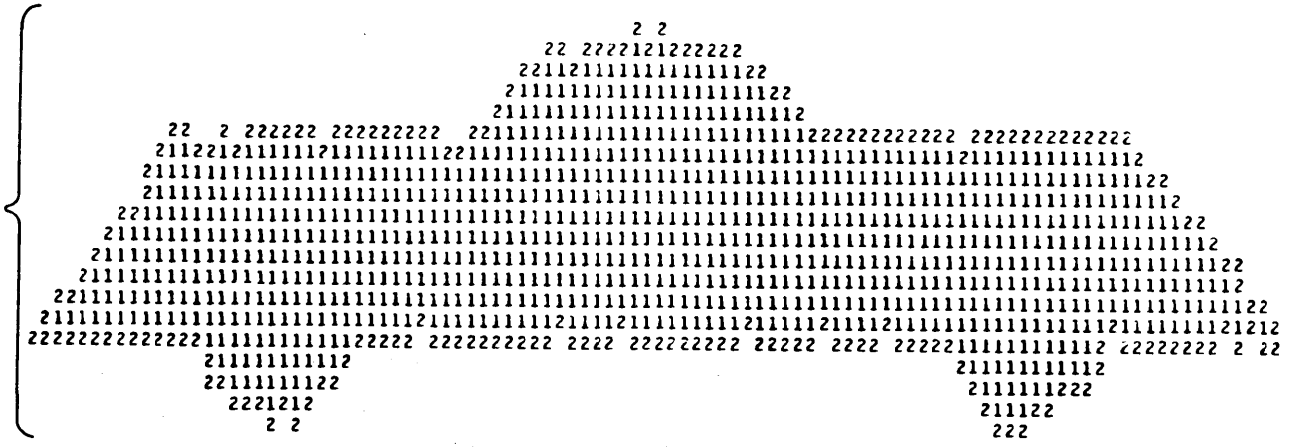
Table XXII. Sample Output for AREA Option (continued)
(Compressed for Display)

```
AZIMUTH    90.0     ELEVATION     0.0

TARGET CENTER      0.000      0.000     31.500 IN.

CENTROID OF AREA
  H =       .0370 M .
  V =       .7544 M .
NUMBER OF CELLS         1866.

CENTROID OF PERIMETER
  H =       .0134 M .
  V =       .7111 M .
NUMBER OF PERIMETER CELLS       220.

FIRST SEED FOR RANDOM NUMBER GENERATOR              0
NEXT  SEED FOR RANDOM NUMBER GENERATOR       11800047

TIME FOR VIEW     2.335 SECONDS


AZIMUTH                    90.000
ELEVATION                   0.000

TARGET PARAMETERS            X          Y          Z
  MINIMUM                -100.000   -36.000      .000
  MAXIMUM                 100.000    36.000    63.000
  CENTER                    0.000     0.000    31.500
  DIMENSIONS              200.000    72.000    63.000

VIEW PLANE
  HORIZONTAL LENGTH       200.000
  VERTICAL LENGTH          63.000
  DEPTH                    72.000
  BACK OFF DISTANCE        56.000
  CENTER                    0.000    31.500
  HORZ CELL SIZE            2.000
  VERT CELL SIZE            3.333
  HORIZONTAL RANGE       -100.000   100.000
  VERTICAL RANGE            0.000    63.333

NUMBER HORZ CELLS             101
NUMBER VERT CELLS              20
NUMBER OF CELLS              2020

FIRST SEED FOR RANDOM NUMBER GENERATOR       11800047

OPTION SET TO CHOOSE RANDOM POINT IN CELL

OPTION SET TO PLOT ON PRINTER
```

Table XXII. Sample Output for AREA Option (continued)
(Compressed for Display)

AZIMUTH 90.0 ELEVATION 0.0

HORIZONTAL CELL SIZE 2.000 IN.
VERTICAL CELL SIZE 3.333 IN.



AZIMUTH 90.0 ELEVATION 0.0

HORIZONTAL CELL SIZE IS 2.000 IN.
VERTICAL CELL SIZE IS 3.333 IN.
AREAS IN SQ.CM.

NUMBER OF CELLS HIT 1110.

REGION	ITEM	PRESENTED AREA	REGION	ITEM	PRESENTED AREA	REGION	ITEM	PRESENTED AREA	REGION	ITEM	PRESENTED AREA
1	40	0.	2	1041	0.	3	100	.29247253E+04	4	100	.35698853E+04
5	101	.38709600E+04	6	100	.31569829E+05	7	651	0.	8	652	.29247253E+04
9	652	0.	10	654	.28817147E+04	11	2701	0.	12	111	0.
13	3031	0.	14	3031	0.	15	3031	0.	16	3031	0.
17	3031	0.	18	3031	0.	19	0	0.	20	0	0.

TOTAL AREA .47741640E+05

ITEM	PRESENTED AREA	ITEM	PRESENTED AREA	ITEM	PRESENTED AREA	ITEM	PRESENTED AREA
0	0.	0	0.	40	0.	100	.31569829E+05
100	.29247253E+04	100	.35698853E+04	101	.38709600E+04	111	0.
651	0.	652	.29247253E+04	653	0.	654	.28817147E+04
1041	0.	2701	0.	3031	0.	3031	0.
3031	0.	3031	0.	3031	0.	3031	0.

Table XXII. Sample Output for AREA Option (continued)
(Compressed for Display)

```
AZIMUTH   90.0    ELEVATION    0.0

TARGET CENTER     0.000     0.000    31.500 IN.

CENTROID OF AREA
  H =      .0340 M .
  V =      .7578 M .
NUMBER OF CELLS        1110.

CENTROID OF PERIMETER
  H =      .0397 M .
  V =      .7128 M .
NUMBER OF PERIMETER CELLS      203.

FIRST SEED FOR RANDOM NUMBER GENERATOR     11900047
NEXT  SEED FOR RANDOM NUMBER GENERATOR      7201143

TIME FOR VIEW      .721 SECONDS

TIME FOR AREA    3.056 SECONDS

LEAVE AREA
```

```
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
A R E A
                    2                       I N C M M
          9 0 .                             2 .       T T   T       M H P
          9 0 .                             2 .         T     T
```

Figure 10. Sample Input for AREA Option

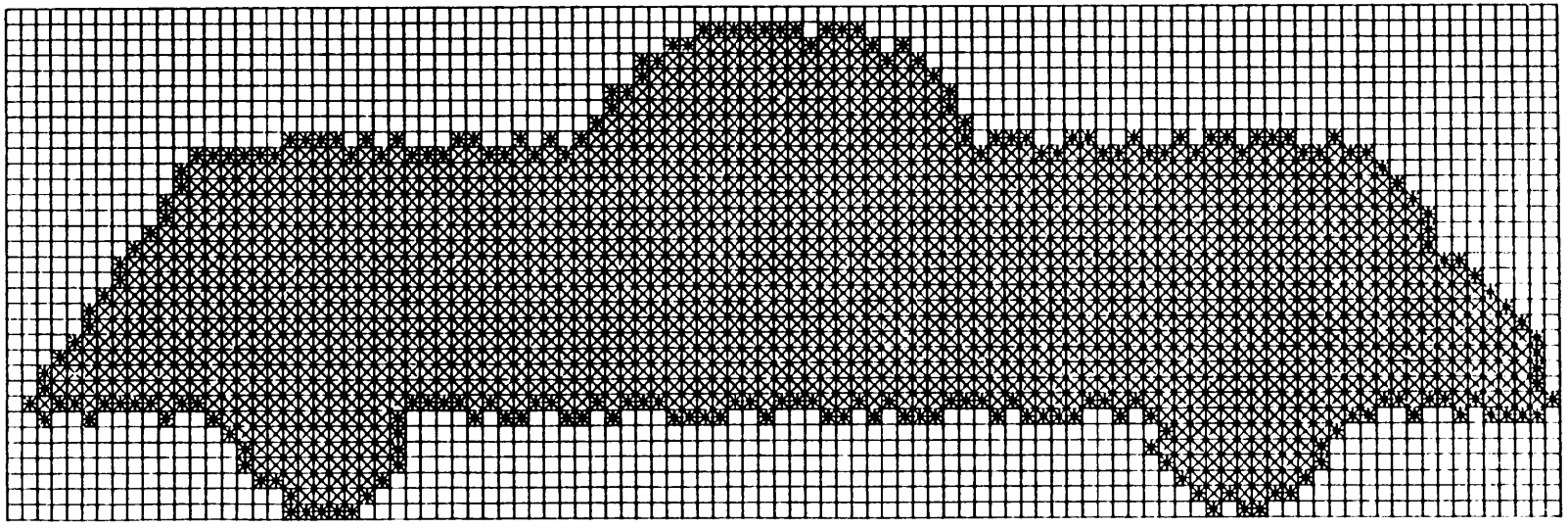


Figure 11. Plot from AREA OPtion Using the Sample Input

B. CHECK Option

The CHECK option's basic task is to search for overlapping regions. It also provides silhouettes, presented areas and volumes of regions from the front, side and top views. It can search for the phanton armor that is generated by the GIFT code when two adjacent regions described as air use different air space codes. It can compute the normal thicknesses of the region at the entrance and exit intersection points of selected rays and the rotation and fallback (azimuth and elevation) angles of a vector normal to the entrance and exit surfaces.

The CHECK option uses a free form type of input which consists of a left adjusted code word in columns 1 through 10 and additional data in columns 11 through 80. All of the code words are optional except "REGION". "REGION" initiates the execution of the CHECK option. The code word "REGION" will be assumed on any input card which has columns 1 through 10 blank. Figures 12 through 20 describe the input for the CHECK option.

Table XXIII depicts the output of the CHECK option obtained by using the sample target COM-GEOM description contained in Table I and the input data for the CHECK option in Figure 21. The CHECK option output for each region consists of three parts. The first part consists of an identification line. The identification line contains the Region Identification Code number or Air Space Code and (if enough room has been allowed in the MASTER-ASTER array) the alphanumeric description of the region. The second part consists of four lines. The first line describes the grid cell and the last three lines describe the region enclosing RPP. The third portion depicts the front, side, and top views consisting of the computed presented area and volume and a printed silhouette of each view of the region. The completed volume of region 6 in Table XXIII is 5287.7 for the front, 9891.1 for side and 20031.0 for top. The volumes for all three views should be roughly equivalent but, in this case, the region is basically a hollow box and those plates describing the sides, top, and bottom are missed by the rays in the front view; similarly plates are missed in the side and top views. In this case, the volume of the region should be the sum of all three views. The character printed depicts the number of pairs (one entering, one exiting) of intersections the ray made with the region. This technique helps to better visualize the region. The top view of region 6 in Table XXIII depicts a hollow shell apparent by the printer character "2" with an elliptical hole in the top or bottom side apparent by the printer character "1". If the number of pairs of intersections is greater than 9, an "M" is printed. If an error is encountered by the ray, a "*" is printed. The front view depicts the 0 degree azimuth and elevation, the side view depicts the 270 degree azimuth and 0 degree elevation, and the top view depicts the 270 degree azimuth and 90 degree elevation aspect angles of the COM-GEOM description. The horizontal axis of the printer plot is numbered from the minimum to maximum value of x or y of the region RPP. The vertical axis of the printer plot is numbered from the maximum to minimum of y or z of the region RPP.

1-10	11-20	21-80
'CELL SIZE'	CELSIZ	

FORMAT (A6,A4,F10.0)

CELSIZ - Specify the vertical length of the grid cell (horizontal length of grid cell is the number (usually 6) of vertical lines per inch divided by 10 times CELSIZ)

(Default = 0.0)

Figure 12. CELL SIZE Card for CHECK Option

1-10	11-20	21-80
'INCREMENT'	CELINC	

FORMAT (A6,A4,F10.0)

CELINC - Specify the number of lengths one of the dimensions of a region RPP is divided

(Default = 10.0)

Figure 13. INCREMENT Card for CHECK Option

1-10	11-20	21-80
'MIN AREA'	AMIN	

FORMAT (A6,A4,F10.0)

AMIN - Specify the minimum area allowed for a grid cell.

(Default = 1.0)

Figure 14. MIN AREA Card for CHECK Option

1-10	11-80
'ALLDEP'	

FORMAT (A6,A4)

Print the normal depths, rotation and fallback angles for all regions.

Figure 15. ALLDEP Card for CHECK Option

1-10	11-15	16-20	21-80
'ARMDEP'	ILWR	IUPR	

FORMAT (A6,A4,2I5)

Print the normal depths, rotation and fallback angles for armor regions only.

ILWR - Specify lower limit of the armor region's item codes.

IUPR - Specify upper limit of the armor region's item codes.

(Default "ILWR" = 100, "IUPR" = 199)

Figure 16. ARMDEP Card for CHECK Option

1-10	11-20	21-30	31-40	41-80
'VIEW'	VIEW(1)	VIEW(2)	VIEW(3)	

FORMAT (A6,A4,3(A5,5X))

VIEW(I) - Specify codes that designate which views are to be checked. Left adjusted codes are:

"FRONT" = Azimuth 0°, Elevation 0°
"SIDE" = Azimuth 270°, Elevation 0°
"TOP" = Azimuth 270°, Elevation 90°
"ALL" = All three previous views

(Default = "ALL")

Figure 17. VIEW Card for CHECK Option

1-6	7-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
CARD(1)		CODES(1)	CODES(2)	CODES(3)	CODES(4)	CODES(5)	CODES(6)	CODES(7)

FORMAT (A6,A4,7(A3,7X))

CARD(1) - "OPTION" Specify options to use
- "NO" Specify options not to use

CODES(I) - Left adjusted codes with one word for every 10 columns. Only the first three characters of each code word is required. Codes are:

"CHK" or "CHECK" - Check regions for overlapping
"PICTUR" - Plot silhouettes of regions on printer
"AIR CHECK" - Check air regions for holes or voids
"DESCRIPTION" - Print solids of region and ray intersections
"REGIONS" - Print ray and intersections
"RAY" - Print ray history by region
"COMPONENT" - Print ray history by item code

(Default "OPTION" = "CHECK" and "PICTUR" ; "NO" = all others)

Figure 18. OPTION Card for CHECK Option

1-10	11-80
'RESET'	

FORMAT (A6,A4)

Reset all default values:

"VIEW" = "ALL"
"OPTION" = "CHECK" and "PICTUR"
"NO" = "REGION", "RAY" and "COMPONENT"
"INCREMENT" = 10.0
"CELL SIZE" = 0.0
"MIN AREA" = 1.0
"ALLDEP" = False
"ARMDEP" = False
"ILWR" = 100
"IUPR" = 199

FIGURE 19. RESET Card for CHECK Option

1-10	11-15	16-20		71-75	76-80
'REGION'	LIST(1)	LIST(2)	...	LIST(13)	LIST(14)

FORMAT (A6,A4,14A5)

LIST(I) - Signify which regions are to be checked and/or pictured. Region numbers or code words are allowed. Allowable code words are:

"ALL" - Do all regions

"ALL EXCEPT" - Check or picture all regions except those listed

"THRU" - Through, "100 thru 150" means do regions 100 thru 150

"END" - Last region number, "100 THRU END" means do regions 100 through the last region

(If Cols 1-80 are all blank, terminate CHECK Option)

Figure 20. REGION Card for CHECK Option

The horizontal and vertical grid cell lengths are the same for all three views and are adjusted to present a "true" picture on the printer. The grid cell lengths can be determined a number of different ways. The default method for determining the grid cell lengths is accomplished by finding the smallest of either the maximum vertical dimension or the maximum horizontal dimension of all three views and dividing it into ten equal segments. If the area of the grid cell is less than the default (1.0) or a specified minimum area, then the grid cell lengths are adjusted to equal the minimum area. If the region would take more room than allowed on the printer page, the grid cell lengths will be adjusted so that it will fit. The printout contained in Table XXIII portrays the default as well as some manual methods of selecting the grid cell size. The vertical cell length (6.0) specified in the second check of region 6 is overridden because the printer plot would not fit the page.

The lines labeled B through G in Table XXIII are an example of the printout obtained by using the input card whose printout is labeled A. The line labeled B is a header line denoting the grid cell location in the matrix of the region silhouette. The lines labeled C through G contain information similar to the error print for overlapping regions previously discussed in Section II.E, GIFT Basics. The lines labeled C

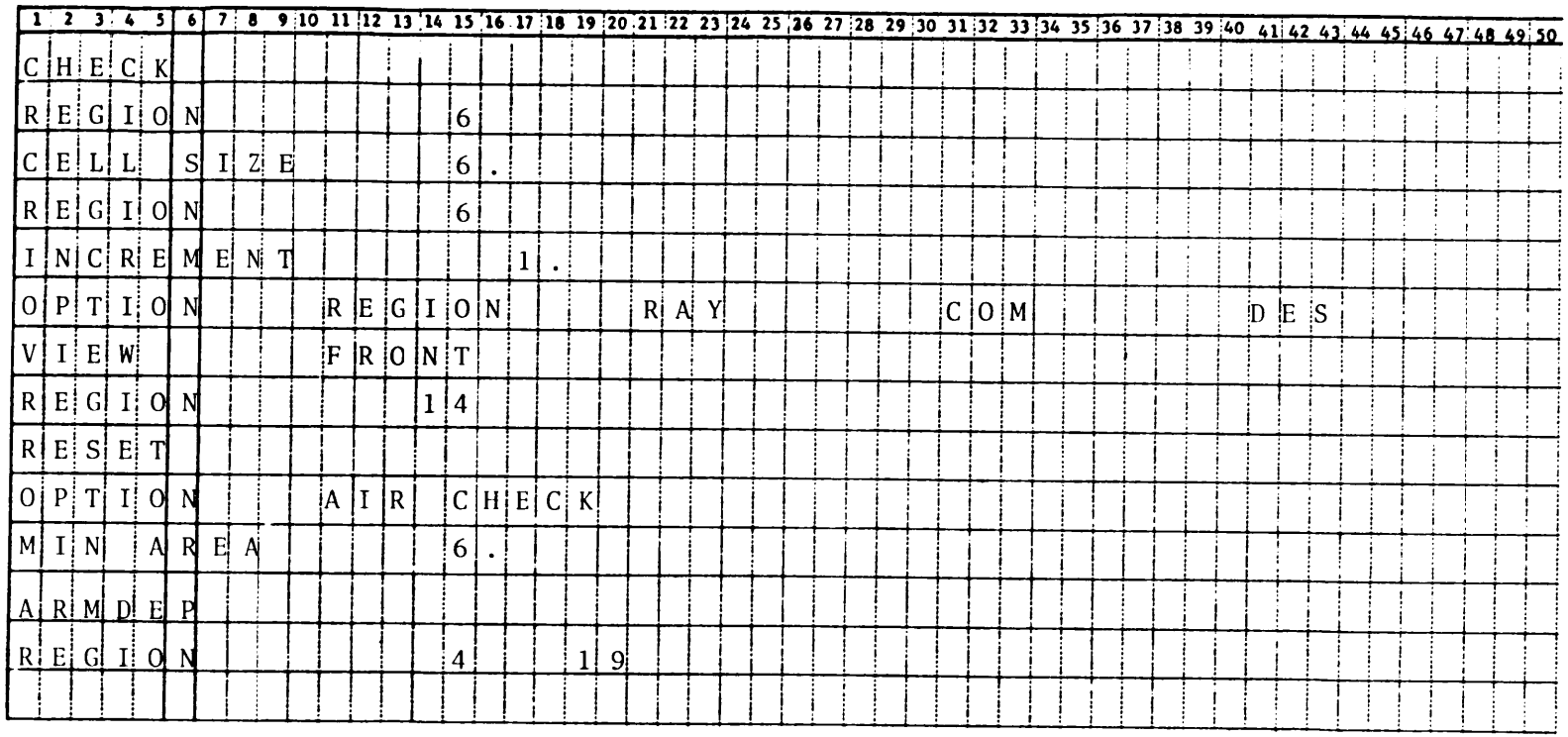


Figure 21. Sample Input for CHECK Option

Table XXIII. Sample Output for CHECK Option (Compressed for Display)

```
ENTER CHECK

REGION          6
REGION      6     ITEM    100     SPACE    0     DESCRIPTION    BODY-CENTER          6-20-19-7-8-9-10 PPP

HORIZONTAL CELL SIZE        4.32      VERTICAL CELL SIZE       7.20     AREA OF CELL        31.10
XMIN       -75.00 XMAX        75.00 XLENGTH      150.00
YMIN       -36.00 YMAX        36.00 YLENGTH       72.00
ZMIN        12.00 ZMAX        48.00 ZLENGTH       36.00

FRONT                                    SIDE                                     TOP
        AREA            VOLUME                   AREA            VOLUME                  AREA            VOLUME
        2643.8           5287.7                  4945.5           9891.1                 10886.4          20031.0
Y-12345678901234567                      x-123456789012345678901234567890123 45  x-123456789012345678901234567890123 45
Z                                        Z                                       Y
1 2222222222222222                       1 22222222222222222222222222222222222    1 211111222222222222222222222222111112
2 2222222222222222                       2 22222222222222222222222222222222222    2 222222222222222222222222222222222222
3 2222222222222222                       3 22222222222222222222222222222222222    3 222222222222222222222222222222222222
4 2222222222222222                       4 22    2222222222222222222222222    22  4 222222222222211111112222222222222
5 2222222222222222                       5 2       22222222222222222222222     2  5 222222222222111111111122222222222
                                                                                  6 222222222222111111111122222222222
                                                                                  7 222222222222211111112222222222222
                                                                                  8 222222222222222222222222222222222
                                                                                  9 222222222222222222222222222222222
                                                                                  0 211111222222222222222222222111112

CELL SIZE       6.

REGION          6


REGION      6     ITEM    100     SPACE    0     DESCRIPTION    BODY-CENTER          6-20-19-7-8-9-10 PPP

HORIZONTAL CELL SIZE        3.75      VERTICAL CELL SIZE       6.25     AREA OF CELL        23.44
XMIN       -75.00 XMAX        75.00 XLENGTH      150.00
YMIN       -36.00 YMAX        36.00 YLENGTH       72.00
ZMIN        12.00 ZMAX        48.00 ZLENGTH       36.00

FRONT                                    SIDE                                     TOP
        AREA            VOLUME                   AREA            VOLUME                  AREA            VOLUME
        2671.9           5343.8                  5156.3          10312.5                 11250.0          20343.8
Y-12345678901234567890                   x-12345678901234567890123456789012345678 90  x-12345678901234567890123456789012345678 90
Z                                        Z                                       Y
1 22222222222222222222                   1 22222222222222222222222222222222222222 22  1 211111122222222222222222222222221111112
2 22222222222222222222                   2 22222222222222222222222222222222222222 22  2 211111122222222222222222222222221111112
3 22222222222222222222                   3 22222222222222222222222222222222222222 22  3 222222222222222222222222222222222222222
4 22222222222222222222                   4 22222222222222222222222222222222222222 22  4 222222222222222222222222222222222222222
5 22222222222222222222                   5 22    22222222222222222222222222    22 22  5 222222222222221111111111222222222222222
6 22222222222222222222                   6 2       22222222222222222222222      2  6 222222222222211111111112222222222222
                                                                                  7 222222222222211111111111222222222222222
                                                                                  8 222222222222221111111111222222222222222
                                                                                  9 222222222222222222222222222222222222222
                                                                                  0 222222222222222222222222222222222222222
                                                                                  1 211111122222222222222222222222221111112
                                                                                  2 211111122222222222222222222222221111112

A   INCREMENT       1.
    OPTION    REGION    RAY       COM       DES
    VIEW      FRONT
    REGION       14
```

Table XXIII. Sample Output for CHECK Option (continued)
(Compressed for Display)

B

```
H    -3.000  V    52.000    IH   1  IV   1    NUMBER OF INTERSECTIONS   1
```

C

```
NUMBER OF INTERSECTIONS OF RAY AND REGION   14 IS   1
   REGION ITEM   DIST IN    DIST OUT     LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
       14 3031   28.41719   29.57022   1.1530    19   -1     5   -1   -22.4172   -3.0000   52.0000   -23.5702  -3.0000   52.0000
```

D

```
REGION    14    ITEM  3031    SPACE   0    DESCRIPTION   MAN-HEAD          14-13              SPH
      OP SOLID TYP       RIN          ROUT         LOS     SURFI SURFO     X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
       *    14 SPH      2.00001     9.99999     8.0000      1     1     4.0000   -3.0000   52.0000   -4.0000   -3.0000   52.0000
```

E

```
STARTING POINT OF RAY          6.00000    -3.00001    52.00001
DIRECTION COSINES OF RAY      -1.00000     0.00000     0.00000
```

F

```
NUMBER OF INTERSECTIONS OF RAY AND ALL COMPONENTS    3
                                REGION (IN)   REGION (OUT)
                                     SOLID         SOLID                                                                  SPACE
ITEM  DIST IN   DIST OUT     LOS          SURF          SURF       X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT      LOS
 111********************    0.00   0   0   0   0   0   0  *********  -3.000   52.000*********  -3.000   52.000   3********
3031   2.0000    10.0000    8.00   14  14   1  14  14  -1      4.000   -3.000   52.000   -4.000   -3.000   52.000   3  18.42
 101  28.4172   29.5702    1.15    5  19  -1   5   5  -1   -22.417   -3.000   52.000  -23.570   -3.000   52.000   9   0.00
```

G

```
NUMBER OF INTERSECTIONS OF RAY AND ALL REGIONS IS    4
 REGION  ITEM    DIST  IN    DIST OUT     LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
     19     0************    2.00001**********    0   0   14    1**********  -3.0000   52.0000   4.0000   -3.0000   52.0000
     14  3031     2.00001     9.99999     8.0000   14   1   14   -1     4.0000   -3.0000   52.0000   -4.0000   -3.0000   52.0000
     19     0     9.99999    28.41719   18.4172    14  -1   19   -1    -4.0000   -3.0000   52.0000  -22.4172   -3.0000   52.0000
      5   101    28.41719    29.57022    1.1530    19  -1    5   -1   -22.4172   -3.0000   52.0000  -23.5702   -3.0000   52.0000
```

```
H     3.000  V    52.000    IH   2  IV   1    NUMBER OF INTERSECTIONS   1

NUMBER OF INTERSECTIONS OF RAY AND REGION   14 IS   1
   REGION ITEM   DIST IN    DIST OUT     LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
       14 3031   28.41719   29.57022   1.1530    19   -1     5   -1   -22.4172   3.0000    52.0000   -23.5702  3.0000    52.0000

REGION    14    ITEM  3031    SPACE   0    DESCRIPTION   MAN-HEAD          14-13              SPH
      OP SOLID TYP       RIN          ROUT         LOS     SURFI SURFO     X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
       *    14 SPH      1.99999     10.00001    8.0000      1     1     4.0000   3.0000    52.0000   -4.0000   3.0000    52.0000

STARTING POINT OF RAY          6.00000     2.99999    52.00001
DIRECTION COSINES OF RAY      -1.00000     0.00000     0.00000

NUMBER OF INTERSECTIONS OF RAY AND ALL COMPONENTS    3
                                REGION (IN)   REGION (OUT)
                                     SOLID         SOLID                                                                  SPACE
ITEM  DIST IN   DIST OUT     LOS          SURF          SURF       X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT      LOS
 111********************    0.00   0   0   0   0   0   0  *********   3.000   52.000*********   3.000   52.000   3********
3031   2.0000    10.0000    8.00   14  14   1  14  14  -1      4.000   3.000    52.000   -4.000   3.000    52.000   3  18.42
 101  28.4172   29.5702    1.15    5  19  -1   5   5  -1   -22.417   3.000    52.000  -23.570   3.000    52.000   9   0.00

NUMBER OF INTERSECTIONS OF RAY AND ALL REGIONS IS    4
 REGION  ITEM    DIST  IN    DIST OUT     LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
     19     0************    1.99999**********    0   0   14    1**********   3.0000   52.0000   4.0000   3.0000    52.0000
     14  3031     1.99999    10.00001    8.0000   14   1   14   -1     4.0000   3.0000    52.0000   -4.0000   3.0000    52.0000
     19     0    10.00001    28.41719   18.4172    14  -1   19   -1    -4.0000   3.0000    52.0000  -22.4172   3.0000    52.0000
      5   101    28.41719    29.57022    1.1530    19  -1    5   -1   -22.4172   3.0000    52.0000  -23.5702   3.0000    52.0000
```

Table XXIII. Sample Output for CHECK Option (continued)
(Compressed for Display)

```
REGION    14    ITEM  3031    SPACE   0    DESCRIPTION   MAN-HEAD          14-13            SPH

HORIZONTAL CELL SIZE      6.00     VERTICAL CELL SIZE     10.00    AREA OF CELL      60.00
XMIN      -5.00 XMAX       5.00 XLENGTH      10.00
YMIN      -5.00 YMAX       5.00 YLENGTH      10.00
ZMIN      47.00 ZMAX      57.00 ZLENGTH      10.00

FRONT                                    SIDE                                TOP
       AREA          VOLUME                     AREA          VOLUME               AREA          VOLUME
      120.0          960.0                       0.0            0.0                0.0            0.0
Y-12                                     X-1                                 X-1
Z                                        Z                                   Y
1 11                                     1                                   1

RESET

OPTION    AIR CHECK

MIN AREA      6.

ARMDEP

REGION        4   19

REGION    4     ITEM   100    SPACE   0    DESCRIPTION   BODY-REAR         4                ARBB

HORIZONTAL CELL SIZE      4.32     VERTICAL CELL SIZE      7.20    AREA OF CELL      31.10
XMIN    -100.00 XMAX     -75.00 XLENGTH      25.00
YMIN     -36.00 YMAX      36.00 YLENGTH      72.00
ZMIN      12.00 ZMAX      48.00 ZLENGTH      36.00

FRONT                                    SIDE                                TOP
       AREA          VOLUME                     AREA          VOLUME               AREA          VOLUME
     2643.8          34534.3                   559.9          35269.2             1555.2          36170.8
Y-123456789012345678                     X-123456                            X-123456
Z                                        Z                                   Y
1 1111111111111111                       1      1                            1      11
2 1111111111111111                       2     11                            2  11111
3 1111111111111111                       3   1111                            3 111111
4 1111111111111111                       4  11111                            4 111111
5 1111111111111111                       5 111111                            5 111111
                                                                             6 111111
                                                                             7 111111
                                                                             8 111111
                                                                             9  11111
                                                                             0     11
```

Table XXIII. Sample Output for CHECK Option (continued)
(Compressed for Display)

H

VIEW	H V	ROT(IN)	FB(IN)	LOS(IN)	NORM(IN)	ROT(OUT)	FB(OUT)	LOS(OUT)	NORM(OUT)
FRONT	(7- 1)	0.0	0.0	3.214	3.214	180.0	41.8	3.214	2.398
FRONT	(3- 2)	0.0	0.0	9.643	9.643	180.0	41.8	9.643	7.193
FRONT	(16- 2)	0.0	0.0	9.643	9.643	180.0	41.8	9.643	7.193
FRONT	(12- 3)	0.0	0.0	16.071	16.071	180.0	41.8	16.071	11.988
FRONT	(8- 4)	0.0	0.0	22.500	22.500	180.0	41.8	22.500	16.784
FRONT	(4- 5)	0.0	0.0	25.000	25.000	180.0	0.0	25.000	25.000
FRONT	(17- 5)	0.0	0.0	3.000	3.000	115.6	0.0	3.000	1.298
SIDE	(6- 1)	-115.6	0.0	70.368	63.438	115.6	0.0	70.368	63.438
SIDE	(5- 2)	-115.6	0.0	66.221	59.700	115.6	0.0	66.221	59.700
SIDE	(3- 3)	-115.6	0.0	57.926	52.222	115.6	0.0	57.926	52.222
SIDE	(6- 3)	-115.6	0.0	70.368	63.438	115.6	0.0	70.368	63.436
SIDE	(5- 4)	-115.6	0.0	66.221	59.700	115.6	0.0	66.221	59.700
SIDE	(4- 5)	-115.6	0.0	62.074	55.961	115.6	0.0	62.074	55.961
TOP	(5- 1)	180.0	41.8	29.258	19.486	0.0	-90.0	29.258	29.258
TOP	(2- 3)	180.0	41.8	14.742	9.819	0.0	-90.0	14.742	14.742
TOP	(5- 4)	180.0	41.8	29.258	19.486	0.0	-90.0	29.258	29.258
TOP	(2- 6)	180.0	41.8	14.742	9.819	0.0	-90.0	14.742	14.742
TOP	(5- 7)	180.0	41.8	29.258	19.486	0.0	-90.0	29.258	29.258
TOP	(2- 9)	180.0	41.8	14.742	9.819	0.0	-90.0	14.742	14.742
TOP	(5-10)	180.0	41.8	29.258	19.486	0.0	-90.0	29.258	29.258

Table XXIII. Sample Output for CHECK Option (continued)
(Compressed for Display)

```
 1  1  1  1  1  1  1  1  1  1  1  1  1  1 WARNING - PHANTOM ARMOR GENERATED FOR RAY  1  1  1  1  1  1  1  1  1  1  1  1  1  1

STARTING POINT OF RAY        -9.48684     12.64912     63.00000
DIRECTION COSINES OF RAY      0.00000      0.00000     -1.00000

NUMBER OF INTERSECTIONS OF RAY AND ALL COMPONENTS    3
                                  REGION (IN)   REGION (OUT)
                                      SOLID         SOLID                                                          SPACE
ITEM  DIST IN    DIST OUT    LOS        SURF          SURF        X IN     Y IN     Z IN     X OUT    Y OUT    Z OUT      LOS
 101   9.2904     12.6817    3.39   5   5   1    5   19   1    -9.487   12.649   53.710   -9.487   12.649   50.318   3   3.32
 111  16.0000     16.0000    0.00   0   0   0    0    0   0    -9.487   12.649   47.000   -9.487   12.649   47.000   2  34.00
 100  50.0000     51.0000    1.00   6  20  -5    6    6  -5    -9.487   12.649   13.000   -9.487   12.649   12.000   9   0.00

NUMBER OF INTERSECTIONS OF RAY AND ALL REGIONS IS    4
 REGION  ITEM    DIST IN     DIST OUT     LOS      SOL SURF   SOL SURF     X IN     Y IN     Z IN     X OUT    Y OUT    Z OUT
      5   101    9.29039     12.68166    3.3913     5    1     19    1   -9.4868  12.6491  53.7096  -9.4868  12.6491  50.3183
     19     0    12.68166    16.00000    3.3183    19    1     20    6   -9.4868  12.6491  50.3183  -9.4868  12.6491  47.0000
     20     0    16.00000    50.00000   34.0000    20    6     20   -5   -9.4868  12.6491  47.0000  -9.4868  12.6491  13.0000
      6   100    50.00000    51.00000    1.0000    20   -5      6   -5   -9.4868  12.6491  13.0000  -9.4868  12.6491  12.0000

INTERSECTIONS OF ALL SOLIDS AND RAY NUMBER   1989
          SOLID TYP      RIN          ROUT         LOS     SURFI SURFO     X IN     Y IN     Z IN     X OUT    Y OUT    Z OUT
              5 ELL     9.29039     20.70961    11.4192      1     1    -9.4868  12.6491  53.7096  -9.4868  12.6491  42.2904
              6 RPP    15.00000     51.00000    36.0000      6     5    -9.4868  12.6491  48.0000  -9.4868  12.6491  12.0000
             19 ELL    12.68166     17.31834     4.6367      1     1    -9.4868  12.6491  50.3183  -9.4868  12.6491  45.6817
             20 BOX    16.00000     50.00000    34.0000      6     5    -9.4868  12.6491  47.0000  -9.4868  12.6491  13.0000

REGION     5    ITEM   101    SPACE   0    DESCRIPTION   BUBBLE              5-6-19              ELL
        OP SOLID TYP      RIN          ROUT         LOS     SURFI SURFO     X IN     Y IN     Z IN     X OUT    Y OUT    Z OUT
         +     5 ELL     9.29039     20.70961    11.4192      1     1    -9.4868  12.6491  53.7096  -9.4868  12.6491  42.2904
         -     6 RPP    15.00000     51.00000    36.0000      6     5    -9.4868  12.6491  48.0000  -9.4868  12.6491  12.0000
         -    19 ELL    12.68166     17.31834     4.6367      1     1    -9.4868  12.6491  50.3183  -9.4868  12.6491  45.6817

REGION    19    ITEM     0    SPACE   3    DESCRIPTION   INSIDE AIR (BUBBLE)                  ELL1
        OP SOLID TYP      RIN          ROUT         LOS     SURFI SURFO     X IN     Y IN     Z IN     X OUT    Y OUT    Z OUT
         +    19 ELL    12.68166     17.31834     4.6367      1     1    -9.4868  12.6491  50.3183  -9.4868  12.6491  45.6817
         -    20 BOX    16.00000     50.00000    34.0000      6     5    -9.4868  12.6491  47.0000  -9.4868  12.6491  13.0000

REGION    20    ITEM     0    SPACE   2    DESCRIPTION   INSIDE AIR (BODY)  20                BOX
        OP SOLID TYP      RIN          ROUT         LOS     SURFI SURFO     X IN     Y IN     Z IN     X OUT    Y OUT    Z OUT
         +    20 BOX    16.00000     50.00000    34.0000      6     5    -9.4868  12.6491  47.0000  -9.4868  12.6491  13.0000

REGION     6    ITEM   100    SPACE   0    DESCRIPTION   BODY-CENTER         6-20-19-7-8-9-10 RPP
        OP SOLID TYP      RIN          ROUT         LOS     SURFI SURFO     X IN     Y IN     Z IN     X OUT    Y OUT    Z OUT
         +     6 RPP    15.00000     51.00000    36.0000      6     5    -9.4868  12.6491  48.0000  -9.4868  12.6491  12.0000
         -    20 BOX    16.00000     50.00000    34.0000      6     5    -9.4868  12.6491  47.0000  -9.4868  12.6491  13.0000
         -    19 ELL    12.68166     17.31834     4.6367      1     1    -9.4868  12.6491  50.3183  -9.4868  12.6491  45.6817

*** END PHANTOM ARMOR ****** END PHANTOM ARMOR ****** END PHANTOM ARMOR ****** END PHANTOM ARMOR ****** END PHANTOM ARMOR ***
```

Table XXIII. Sample Output for CHECK Option (continued)
(Compressed for Display)

```
REGION    19    ITEM     0    SPACE   3    DESCRIPTION   INSIDE AIR (BUBBLE)                ELL1

HORIZONTAL CELL SIZE      1.90     VERTICAL CELL SIZE      3.16    AREA OF CELL        6.00
XMIN      -24.00 XMAX      24.00 XLENGTH      48.00
YMIN      -14.00 YMAX      14.00 YLENGTH      28.00
ZMIN       34.00 ZMAX      62.00 ZLENGTH      28.00

FRONT
       AREA          VOLUME
         366.0        11673.4
Y-123456789012345
Z
1      1111111
2    11111111111
3   1111111111111
4 11111111111111
5 11111111111111
6
7
8
9

SIDE
       AREA          VOLUME
         618.0        11623.1
X-123456789012345678901234 5
Z
1         11111111111
2     1111111111111111111
3   11111111111111111111111
4 1111111111111111111111111
5 1111111111111111111111111
6
7
8
9

TOP
       AREA          VOLUME
        1066.0        11039.9
X-123456789012345678901234 5
Y
1         11111111111
2     1111111111111111111
3   11111111111111111111111
4 1111111111111111111111111
5 1111111111111111111111111
6 11111111111111111111111111
7   111111111111111111111
8     1111111111111111111
9         11111111111

TOTAL TIME FOR CHECK      1.889 SECONDS

LEAVE CHECK

END OF RUN
```

were printed for the "REGION" code word, lines labeled D were printed for the "DES" code word, lines labeled F were printed for the "COM" code word, and lines labeled G were printed for the "RAY" code word on the input card labeled A. The lines labeled E are printed whenever either "COM" or "RAY" option is specified.

The lines labeled H are printed when the "ARMDEP" or "ALLDEP" option card is used. The lines contain the rotation (azimuth) and fallback (elevation) angles for the view from which one would observe the surface perpendicularly at the entrance and exit points of the ray, the ray distance (LOS) through the region for the first and last pair of intersections, and a normal distance through the first and last pair of intersections. The normal distance is computed by using the LOS times the cosine of the angle between the normal vector and the ray. The line indicated in Table XXIII by an arrow defines the normal distances, rotation and fallback angles, etc. for a ray in grid cell 12-3 (the one circled in the silhouette) of the front view of region 4. The rotation ("ROT(IN)") and fallback ("FB(IN)") angles at the entrance point are both zero; therefore, the first surface is perpendicular to the front view. The "LOS(IN)" is equal to the "LOS(OUT)" because there is only one pair of intersections for this ray.

The section of the printout in Table XXIII starting with the line "1 1 1 ... WARNING - PHANTOM ARMOR GENERATED FOR RAY ... 1 1 1" is generated whenever phantom armor is encountered by a ray used to check a region defined with an air space code in the Region Identification Table and the "OPTION" card contains "AIR CHECK" in the appropriate columns. The integer ("1" in the example) is the number of legitimate phantom armors that were generated. The data printed which follows the phantom armor warning is similar to the data in an error print for two overlapping regions.

C. GRID Option

The GRID option produces parallel ray data generally used for vulnerability analysis. The data is generated using a grid previously described in Section II.E. GIFT Basics, and consists of ray distances through components, normal distances through components, obliquity angles and ray distances through air spaces. The GRID output can also be used to check the COM-GEOM description for adjacent air spaces with different air space codes. Figures 22 through 24 describe the input for the GRID option.

Table XXIV is the output of the GRID option using the sample target COM-GEOM description in Table I and the GRID option input of Figure 25. The portion of the printout labeled A describes the enclosing RPP of the target. The portion of the printout labeled B describes the grid for this view.

The output from the GRID option can be printed and written on FORTRAN units 1 and 10. The data on FORTRAN unit 10 can be written in two forms but both are written in binary (unformatted). The

1-10	11-20	21-30	31-40	41-50	51-60	61	62-70	71-80
NOAA	IWOT	NOPRNT	NFORM	IRPP	NVEH	NORMV	IFORM	NOPRV

FORMAT (6I10,I1,I9,I10)

NOAA - Specify number of aspect angles.

IWOT - If not zero, write grid cell data on FORTRAN Unit 1.

NOPRNT - If zero, write grid cell data on printer.

NFORM - Specify form of output desired on FORTRAN Unit 1.

1 or 4 - Output one component per line. Compute obliquity angle and normal distances through component at the entrance and exit point of intersection of a ray and component.

0 or 2 or 5 - Output two components per line. Compute obliquity angle and normal distances through component at the entrance point of intersection of the ray and the component.

3 or 6 - Output three components per line. Compute obliquity angle of the component at the entrance point of intersection of the ray and the component.

(4, 5, 6 have a slightly different format. See the discussion of the output for details)

IRPP - If not zero, read a Target Enclosing RPP card.

NVEH - If not zero, generate VAREA type output. If greater than zero, write VAREA type output on FORTRAN Unit 10. If less than zero, do not write VAREA type output on FORTRAN Unit 10.

NORMV - Can only be used if VAREA output is specified. If equal zero, compute the obliquity angle at the entrance point of the intersection of a ray and a component. If not equal zero, compute the obliquity angle and normal distance through component at the entrance point of the intersection of a ray and component.

IFORM - Specify the form of the VAREA output. If zero, output in documented VAREA format. If not zero, output in packed format.

NOPRV - If not zero, do not print VAREA output.

Figure 22. Control Card for GRID Option

1-10	11-20	21-30	31-40	41-50	51-60	61-80
XMIN	XMAX	YMIN	YMAX	ZMIN	ZMAX	

FORMAT (6F10.0)

The minimum (min) and the maximum (max) values of the x, y and z coordinates which bound the rectangular parallelepiped that encloses the COM-GEOM description. (Default is the computed Enclosing RPP located at LENRPP in ASTER)

Figure 23. Target Enclosing RPP Card for GRID Option (Optional, read only if IRPP not zero on Control Card)

1-10	11-20	21-30	31-40	41-50	51-60	61-80
A	E	CELSIZ	GROUND	MAXERR	ICENTR	

FORMAT (4E10.3,3I10)

A - Specify azimuth angle in degrees.

E - Specify elevation angle in degrees.

CELSIZ - Specify grid cell size (Default = 4.0).

GROUND - Specify z-coordinate for the ground of the COM-GEOM description. A ray will not be traced from any location which is less than GROUND. Specifying a value for GROUND should only be considered when a negative elevation angle (E) is specified. (Default = ZMIN of the Target Enclosing RPP)

MAXERR - Specify the maximum number of overlap errors that will be tolerated for each view.

ICENTR - If zero, rays are tracked through a random point in the grid cell. If not zero, rays are tracked through the center of the grid cell.

Figure 24. View Card for GRID Option

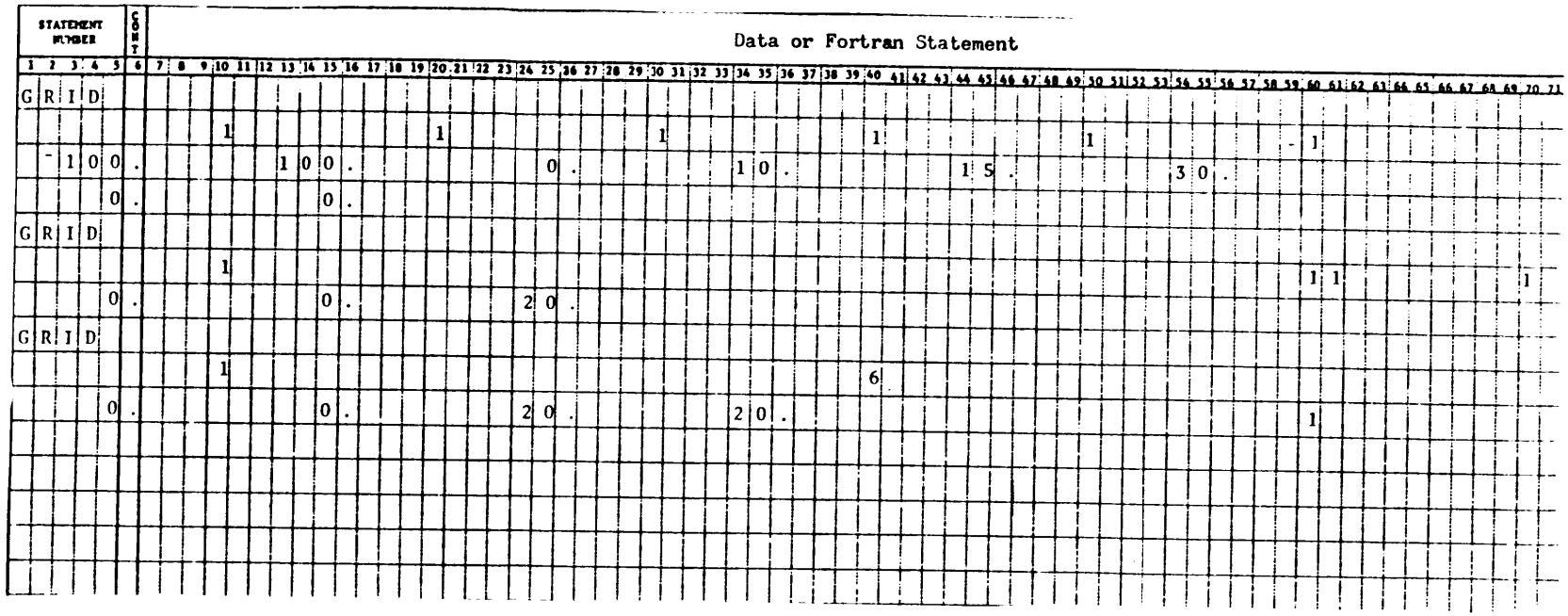


Figure 25. Sample Input for GRID Option

Table XXIV. Sample Output for GRID Option on Printer
(Compressed for Display)

```
ENTER GRID

NUMBER OF ASPECT ANGLES     1

AZIMUTH                   0.000
ELEVATION                 0.000

                            X          Y          Z
A  TARGET MINIMUM        -100.000     0.000     15.000
   TARGET MAXIMUM         100.000    10.000     30.000
   TARGET CENTER            0.000     5.000     22.500
   TARGET DIMENSIONS      200.000    10.000     15.000

        PLANE
B  BACK OFF DISTANCE      120.000
   GROUND                   0.000
   CELL SIZE                4.000
   HORIZONTAL LENGTH       10.000
   VERTICAL LENGTH         15.000
   CENTER                   5.000    22.500
   HORIZONTAL RANGE         0.000    12.000
   VERTICAL RANGE          16.000    32.000

NUMBER HORZ CELLS              4
NUMBER VERT CELLS              5
NUMBER OF CELLS               20

FIRST SEED FOR RANDOM NUMBER GENERATOR                    0

OPTION SET TO COMPUTE RANDOM POINT IN CELL

OPTION TO WRITE ON TAPE 1

OPTION SET TO COMPUTE OBLIQUITY ANGLE AND NORMAL DISTANCE FOR ENTRANCE AND EXIT
     AND PRINT 1 COMPONENT PER CARD

OPTION SET TO GENERATE VAREA OUTPUT
     FORMATTED FOR DOCUMENTED VAREA

OBLIQUITY ANGLE ONLY

OPTION SET FOR NO OUTPUT ON TAPE 1C
```

Table XXIV. Sample Output for GRID Option on Printer (continued)
(Compressed for Display)

```
     0.00     0.00     4.00    -1   12.00    0.00   32.00    16.00

      88.5      8.0     28.0          100     14.47   23500
        .8      8.0     28.0         3031      1.63   27676
     -30.0      8.0     28.0         2701     40.00   20000
     -74.0      8.0     28.0          100     18.32   90042
      87.6      4.0     28.0          100     13.64   23500
      22.5      4.0     28.0           40      2.00   20202
       4.5      4.0     28.0         3031      8.91   21919
     -30.0      4.0     28.0         2701     40.00   20000
     -74.0      4.0     28.0          100     17.25   90042
      88.7      0.0     28.0          100     14.75   23500
      21.7      0.0     28.0           40       .38   27979
       4.9      0.0     28.0         3031      9.71   20909
     -30.0      0.0     28.0         2701     40.00   20000
     -74.0      0.0     28.0          100     18.68   90042
      91.0      8.0     24.0          100     16.97   23500
       9.2      8.0     24.0         3031     12.02   27344
     -30.0      8.0     24.0         2701     40.00   20000
     -74.0      8.0     24.0          100     21.54   90042
      91.2      4.0     24.0          100     17.25   23500
      10.9      4.0     24.0         3031     14.06   27139
     -30.0      4.0     24.0         2701     40.00   20000
     -74.0      4.0     24.0          100     21.89   90042
      93.5      8.0     20.0          100     19.47   23500
     -30.0      8.0     20.0         2701     40.00   20000
C    -74.0      8.0     20.0          100     25.11   90042
      95.4      4.0     20.0          100     21.42   23500
      26.5      4.0     20.0         3031     13.17   26871
     -30.0      4.0     20.0         2701     40.00   20000
     -74.0      4.0     20.0          100     26.00   90000
      94.6      0.0     20.0          100     20.56   23500
     -30.0      0.0     20.0         2701     40.00   20000
     -74.0      0.0     20.0          100     26.00   90000
      96.3      4.0     16.0          100     22.25   23500
      26.9      4.0     16.0         3031     11.51   27073
     -30.0      4.0     16.0         2701     40.00   20000
     -74.0      4.0     16.0          100     26.00   90000
      97.6      0.0     16.0          100     23.64   23500
     -30.0      0.0     16.0         2701     40.00   20000
     -74.0      0.0     16.0          100     26.00   90000
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
       0.0      0.0      0.0            0      0.00       0
```

Table XXIV. Sample Output for GRID Option on Printer (continued)
(Compressed for Display)

Table XXIV. Sample Output for GRID Option on Printer (continued) (Compressed for Display)

0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0
0.0	0.0	0.0	0	0.00	0

```
END OF CASE      1
NUMBER OF RAY TRACKING ERRORS ENCOUNTERED        0

FIRST SEED FOR RANDOM NUMBER GENERATOR           0
NEXT  SEED FOR RANDOM NUMBER GENERATOR    62646367

TIME FOR CASE      1       .086 SECONDS


TOTAL TIME FOR GRID       .090 SECONDS

LEAVE GRID
```

Table XXIV. Sample Output for GRID Option on Printer (continued)
(Compressed for Display)

```
ENTER GRID

NUMBER OF ASPECT ANGLES     1

AZIMUTH                   0.000
ELEVATION                 0.000

                          X          Y          Z
TARGET MINIMUM         -100.000   -36.000      .000
TARGET MAXIMUM          100.000    36.000    63.000
TARGET CENTER             0.000     0.000    31.500
TARGET DIMENSIONS       200.000    72.000    63.000

     PLANE
BACK OFF DISTANCE       120.000
GROUND                    0.000
CELL SIZE                20.000
HORIZONTAL LENGTH        72.000
VERTICAL LENGTH          63.000
CENTER                    0.000    31.500
HORIZONTAL RANGE        -40.000    40.000
VERTICAL RANGE            0.000    60.000

NUMBER HORZ CELLS             5
NUMBER VERT CELLS             4
NUMBER OF CELLS              20

FIRST SEED FOR RANDOM NUMBER GENERATOR                    0

OPTION SET TO COMPUTE RANDOM POINT IN CELL

OPTION SET TO GENERATE VAREA OUTPUT
     IN PACKED FORMAT

OBLIQUITY ANGLE AND NORMAL DISTANCE

OPTION SET TO WRITE TAPE 10
```

Table XXIV. Sample Output for GRID Option on Printer (continued)
(Compressed for Display)

D

```
 0.00      0.00     20.00     1    40.00   -40.00     60.00      0.00

  79867140100.              5.86              400023500.
-30009992701.              40.00              400020000.
-74007250100.               7.25              400090042.
 77083750100.       -20000003.08              400023500.
-74003680100.       -20000003.68              400090042.
 90979990100.        20000016.97              200023500.
-74009990100.        20000026.00              200090000.
 90979990100.       -20000016.97              200023500.
-74009990100.       -20000021.54              200090042.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.
           0.               0.00                      0.

END OF CASE     1
NUMBER OF RAY TRACKING ERRORS ENCOUNTERED         0

FIRST SEED FOR RANDOM NUMBER GENERATOR             0
NEXT  SEED FOR RANDOM NUMBER GENERATOR      62646367

TIME FOR CASE     1      .034 SECONDS


TOTAL TIME FOR GRID      .035 SECONDS

LEAVE GRID
```

Table XXIV. Sample Output for GRID Option on Printer (Compressed for Display) (Con't)

```
NUMBER OF ASPECT ANGLES     1

AZIMUTH                   0.000
ELEVATION                 0.000

                            X          Y          Z
TARGET MINIMUM         -100.000    -36.000      .000
TARGET MAXIMUM          100.000     36.000    63.000
TARGET CENTER             0.000      0.000    31.500
TARGET DIMENSIONS       200.000     72.000    63.000

     PLANE
BACK OFF DISTANCE       120.000
GROUND                     .000
CELL SIZE                20.000
HORIZONTAL LENGTH        72.000
VERTICAL LENGTH          63.000
CENTER                    0.000     31.500
HORIZONTAL RANGE        -40.000     40.000
VERTICAL RANGE            0.000     60.000

NUMBER HORZ CELLS             5
NUMBER VERT CELLS             4
NUMBER OF CELLS              20

FIRST SEED FOR RANDOM NUMBER GENERATOR              0

OPTION SET TO CHOOSE CENTER OF CELL

OPTION SET TO IGNORE NORMAL DISTANCE CALCULATION AND PRINT 3 COMPONENTS PER CARD

    0.     60.       0.0      60.0  2    15.0   -15.0 A   0.0 E   0.0
101     2.6 65.8  2   24.7 101     2.6 70.7  9     0.0   0     0.0   0.0  0     0.0

   20.     40.      20.0      40.0  2    80.6   -82.1 A   0.0 E   0.0
100     6.6 34.8  2  148.0 100     8.1  0.0  9     0.0   0     0.0   0.0  0     0.0

    0.     40.       0.0      40.0  4    80.6   -82.1 A   0.0 E   0.0
100     6.6 34.8  2   41.91041    10.6 79.4  2   16.53031   10.0    .0  2    69.0
100     8.1  0.0  9     0.0   0     0.0  0.0  0     0.0   0     0.0   0.0  0     0.0

  -20.     40.     -20.0      40.0  2    80.6   -82.1 A   0.0 E   0.0
E 100     6.6 34.8  2  148.0 100     8.1  0.0  9     0.0   0     0.0   0.0  0     0.0

   20.     20.      20.0      20.0  2    86.1  -100.0 A   0.0 E   0.0
100    12.1 34.8  2  148.0 100    26.0  0.0  9     0.0   0     0.0   0.0  0     0.0

    0.     20.       0.0      20.0  3    94.4  -100.0 A   0.0 E   0.0
100    20.4 34.8  2  104.02701    40.0  0.0  2     4.0 100    26.0   0.0  9     0.0

  -20.     20.     -20.0      20.0  2    86.1  -100.0 A   0.0 E   0.0
100    12.1 34.8  2  148.0 100    26.0  0.0  9     0.0   0     0.0   0.0  0     0.0

END OF CASE     1
NUMBER OF RAY TRACKING ERRORS ENCOUNTERED       0

FIRST SEED FOR RANDOM NUMBER GENERATOR              0
NEXT  SEED FOR RANDOM NUMBER GENERATOR        2321815

TIME FOR CASE     1      .022 SECONDS


TOTAL TIME FOR GRID      .023 SECONDS

LEAVE GRID
```

section of Table XXIV labeled C is an example of the output generated for the documented VAREA[4] code as it would exist on FORTRAN Unit 10. The section labeled D is an example of the output generated for the packed form of input for the VAREA code. Table XXV explains the data generated for VAREA. The value of D, H, and V in Table XXV is for the entrance point of the ray intersections with the component (item). If the value of D is negative, the entrance point is behind the view plane from the direction of target is viewed. The end of the view for both forms is flagged by a filemark. The end of the last block of information for both forms may be filled with zeros if not enough data were generated.

The section of Table XXIV labeled E is an example of the form of output as it would exist on formatted FORTRAN Unit 1 with a "6" specified in columns 31-40 of the Control card for GRID option. Table XXVI is a listing of a sample with a "0" or "2" specified in columns 31-40 of the Control card for GRID option. Figures 26 through 34 explain the output generated on FORTRAN Unit 1. The output generated on FORTRAN Unit 1 when "4", "5", or "6" is specified in columns 31-40 of the Control card for GRID option, is basically similar to "1", "2", or "3" being specified, respectively. The formats for "4", "5", and "6" are specified in the second parenthesis after "FORMAT" in Figures 28 through 33.

D. MOMENT Option

The MOMENT option of the GIFT code computes the center of gravity, the moments of inertia about each of the three coordinate axes, the weight of each component and the total weight, total volume of all components and all air spaces, the total presented area and the average angle between the ray and the normal vector for the first components hit for each view. The MOMENT option of the GIFT code estimates the volume and the centroid of a rectangular parallelepiped which simulates a portion of the individual components intersected by a ray from three grid planes (front view, azimuth 0°, elevation 0°; side view, azimuth 90°, elevation 0°; and top view, azimuth 0°, elevation 90°). Figure 35 depicts the model simulation of the MOMENT option. The top line of the figure shows the grid cell projected through components of a hypothetical target and indicates a random but reproducible location within the grid cell of the representative shotline and where it enters and exits each component. The middle row of objects depicts the true shape of the volume intersection of the ray cylinder and the various target components. The bottom line portrays the set of rectangular parallelepiped volumes which are simulated by and located by the MOMENT option. The mass of each simulated ray component is obtained from the

4. *VAREA Computer Program, VOL I, User Manual, 61JTCG/ME-71-6-1, Joint Technical Coordinating Group for Munitions Effectiveness, Falcon Research and Development Company, Denver, CO, Feb 1971.*

Table XXV. VAREA Input Generated by GRID Option on FORTRAN Unit 10

Record 1 View Information (for both forms of VAREA input)

A - Azimuth angle in degrees

E - Elevation angle in degrees

CELSIZ - Grid cell size in viewing plane

NVEH - Vehicle number

HMAX - Maximum horizontal coordinate in grid

HMIN - Minimum horizontal coordinate in grid

VMAX - Maximum vertical coordinate in grid

VMIN - Minimum vertical coordinate in grid

Documented VAREA Output (Blocks of 170 components with 6 words per component)

SHOT(1)	(D)	Distance from view plane
SHOT(2)	(H)	Horizontal coordinate in view plane
SHOT(3)	(V)	Vertical coordinate in view plane
SHOT(4)		Packed word (NNNN NNNN IIII) containing the integer value of the normal distance through item from entrance point times 100 (N) and the item code number (I)
SHOT(5)		Distance ray travels through item
SHOT(6)		Packed word (SSSS BB LL) containing the code for the air space following items (S), the integer value of angle between normal vector and ray at entrance point (B) and the integer value of the angle between normal vector and ray at exit point (L)

Table XXV. VAREA Input Generated by GRID Option on FORTRAN Unit 10 (continued)

Packed form of input for VAREA

(Blocks of 42 components with three words per component)

PSHOT(1) - Packed word (DDDDDDDDD NNN IIII) containing integer value of the distance from viewing plane times 100 (D), integer value of the normal distance through item from entrance points times 100 (N) and the item code number (I).

PSHOT(2) - Packed word (HHHHHHHHHH DDD.DD) containing integer value of the horizontal coordinate in viewing plane times 100 (H) and the distance ray travels through item (D).

PSHOT(3) - Packed word (VVVVVVVVVV S BB LL) containing the integer value of the vertical coordinate in view plane times 100 (V), the code for the air space following item (S), the integer value of angle between normal vector and ray at entrance point (B) and the integer value of the angle between normal vector and ray at exit point (L).

Table XXVI. GRID Option Output on FORTRAN Unit 1 Using Sample Input

```
 1 10/30/78 SAMPLE INPUT FOR GIFT
     0.                      0.                  .500E+01  .225E+02  .400E+01
    8.0    20.0     7.400    25.600   4   38.47  -92.32 A   0.0 E     0.0
 100  14.47   0.00  34.8     0.00    0.0  2  73.19                          2   7   1
3031   1.83   0.00  76.1     0.00   76.1  2  29.19                          2   7   2
2701  40.00   0.00   0.0     0.00    0.0  2   4.00                          2   7   3
 100  18.32   0.00   0.0     0.00   41.8  9   0.00                          2   7   4
    4.0    28.0     3.400    29.800   5   87.64  -91.25 A   0.0 E     0.0
 100  13.64   0.00  34.8     0.00    0.0  2  51.50                          1   7   1
  40   2.00   0.00   2.2     0.00    2.2  2  10.04                          1   7   2
3031   8.91   0.00  18.7     0.00   18.7  2  25.54                          1   7   3
2701  40.00   0.00   0.0     0.00    0.0  2   4.00                          1   7   4
 100  17.25   0.00   0.0     0.00   41.8  9   0.00                          1   7   5
    0.0    28.0     1.800    28.200   5   88.75  -92.68 A   0.0 E     0.0
 100  14.75   0.00  34.8     0.00    0.0  2  52.31                          0   7   1
  40    .38   0.00  79.2     0.00   79.2  2  10.40                          0   7   2
3031   9.71   0.00   9.4     0.00    9.4  2  25.15                          0   7   3
2701  40.00   0.00   0.0     0.00    0.0  2   4.00                          0   7   4
 100  18.88   0.00   0.0     0.00   41.8  9   0.00                          0   7   5
    8.0    24.0     6.200    25.000   4   90.97  -95.54 A   0.0 E     0.0
 100  16.97   0.00  34.8     0.00    0.0  2  64.79                          2   6   1
3031  12.02   0.00  72.7     0.00   44.4  2  27.19                          2   6   2
2701  40.00   0.00   0.0     0.00    0.0  2   4.00                          2   6   3
 100  21.54   0.00   0.0     0.00   41.8  9   0.00                          2   6   4
    4.0    24.0     5.800    24.600   4   91.25  -95.89 A   0.0 E     0.0
 100  17.25   0.00  34.8     0.00    0.0  2  63.11                          1   6   1
3031  14.06   0.00  70.6     0.00   39.1  2  26.83                          1   6   2
2701  40.00   0.00   0.0     0.00    0.0  2   4.00                          1   6   3
 100  21.89   0.00   0.0     0.00   41.8  9   0.00                          1   6   4
    8.0    20.0     9.400    21.000   3   93.47  -99.11 A   0.0 E     0.0
 100  19.47   0.00  34.8     0.00    0.0  2 104.00                          2   5   1
2701  40.00   0.00   0.0     0.00    0.0  2   4.00                          2   5   2
 100  25.11   0.00   0.0     0.00   41.8  9   0.00                          2   5   3
    4.0    20.0     4.600    18.600   4   95.42 -100.00 A   0.0 E     0.0
 100  21.42   0.00  34.8     0.00    0.0  2  47.53                          1   5   1
3031  13.17   0.00  67.8     0.00   71.1  2  43.30                          1   5   2
2701  40.00   0.00   0.0     0.00    0.0  2   4.00                          1   5   3
 100  26.00   0.00   0.0     0.00    0.0  9   0.00                          1   5   4
    0.0    20.0      .600    19.800   3   94.58 -100.00 A   0.0 E     0.0
 100  20.58   0.00  34.8     0.00    0.0  2 104.00                          0   5   1
2701  40.00   0.00   0.0     0.00    0.0  2   4.00                          0   5   2
 100  26.00   0.00   0.0     0.00    0.0  9   0.00                          0   5   3
    4.0    16.0     5.400    17.400   4   96.25 -100.00 A   0.0 E     0.0
 100  22.25   0.00  34.8     0.00    0.0  2  45.14                          1   4   1
3031  11.51   0.00  89.9     0.00   72.7  2  47.35                          1   4   2
2701  40.00   0.00   0.0     0.00    0.0  2   4.00                          1   4   3
 100  26.00   0.00   0.0     0.00    0.0  9   0.00                          1   4   4
    0.0    16.0     1.800    15.400   3   97.64 -100.00 A   0.0 E     0.0
 100  23.64   0.00  34.8     0.00    0.0  2 104.00                          0   4   1
2701  40.00   0.00   0.0     0.00    0.0  2   4.00                          0   4   2
 100  26.00   0.00   0.0     0.00    0.0  9   0.00                          0   4   3
 999.9                                                                          END
```

1-5	6-15	16-75	76-80
NOAA	DATE	ITITLE	

FORMAT (I5,A10,6A10)

NOAA - Number of views

DATE - Date tape was written e.g., June 10, 73

ITITLE - COM-GEOM description title

Figure 26. Title Line of GRID Option Output on FORTRAN Unit 1 (for all forms)

1-20	21-40	41-50	51-60	61-70	71-80
A	E	TCENTR(1)	TCENTR(2)	TCENTR(3)	CELSIZ

FORMAT (2E20.8,4E10.3)

A - Azimuth angle of view

E - Elevation angle of view

TCENTR(I) - x, y, z coordinates of the center of the target

CELSIZ - Grid cell size

Figure 27. View Line of GRID Output on FORTRAN Unit 1 (for all forms)

1-7	8-14	15-23	24-32	33-35	36-43	44-51	52	53	54-59	60	61	62-67	68-80
HCENTR	VCENTR	H	V	NCOMP	DFIRST	DLAST		'A'	A		'E'	E	

FORMAT (2F7.1,2F9.3,I3,2F8.2,1X,1HA,F6.1,1X,1HE,F6.1)(2F7.0,2F9.1,I3,2F8.1,1X,1HA,F6.1,1X,1HE,F6.1)

HCENTR - Horizontal center coordinate of grid cell

VCENTR - Vertical center coordinate of grid cell

H - Actual horizontal coordinate in view plane

V - Actual vertical coordinate in view plane

NCOMP - Number of components (items) hit by ray

FIRST - Distance from first contact to view plane

LAST - Distance from last contact to view plane

A - Azimuth angle in degrees

E - Elevation angle in degrees

Figure 28. Cell Identification Line of GRID Output on FORTRAN Unit 1 (1 component per line)

1-4	5-11	12-18	19-24	25-31	32-37	38-40	41-47	48-68	69-72	73-76	77-80
ITEM(I)	CLOS(I)	CNORM(I)	CANGI(I)	CNORM(I)	CANGO(I)	KSPAC(I)	SLOS(I)		IH	IV	N

FORMAT (I4,2F7.2F6.1,F7.2,F6.1,I3,F7.2,21X,314) (I4,2F7.1,F6.1,F7.1,F6.1,I3,F7.1,21X,314)

ITEM(I) - Item code number

CLOS(I) - Distance ray traveled through item

CNORM(I) - Normal distance through item from entrance point

CANGI(I) - Angle between normal vector and ray at entrance point

CNORM(I) - Normal distance trhough item from exit point

CANGO(I) - Angle between normal vector and ray at exit point

KSPAC(I) - Code for air space following item

SLOS(I) - Distance ray traveled through air space

IH - Horizontal matrix position of grid cell

IV - Vertical matrix position of grid cell

N - Cumulative count of items

Figure 29. Ray Data Lines of GRID Output on FORTRAN Unit 1 (1 component per line)

1-6	7-13	14-16	17-24	25-32	33-40	41-43	44-47	48-50	51-59	60-68	69	70	71-74	75-76	77-80
HCENTR	VCENTR	IHIV	DFIRST	DLAST		NCOMP	IH	IV	H	V		'A'	A	'E'	E

FORMAT (F6.0,F7.1,I3,2F8.2,8X,I3,I4,2F9.3,1X,1HA,F4.0,1H,,1HE,F4.0)(I6,F7.0,I3,2F8.1,8X,I3,I4, I3,2F9.1,1X,1HA,F4.0,1H,,1HE,F4.0)

HCENTR - Horizontal center coordinate of grid cell in view plane

VCENTR - Vertical center coordinate of grid cell in view plane

IHIV - Two digit random number

DFIRST - Distance from first contact to view plane

DLAST - Distance from last contact to view plane

NCOMP - Number of components hit

IH - Horizontal matrix position of grid cell

IV - Vertical matrix position of grid cell

H - Actual horizontal coordinate in view plane

V - Actual vertical coordinate in view plane

A - Azimuth angle in degrees

E - Elevation angle in degrees

Figure 30. Cell Identification Line of GRID Output on FORTRAN Unit 1 (2 components per line)

1-4	5-11	12-18	19-24	25-27	28-34	35-68	69-72	73-75	76-80
ITEM(I)	CLOS(I)	CNORMI(I)	CANGI(I)	KSPAC(I)	SLOS(I)	SAME AS COLS 1-34	IH	IV	N

FORMAT (2(I4,2F7.2,F6.1,I3,F72.),I4,I3,I5) (2(I4,2F7.1,F6.1,I3,F7.1),I4,I3,I5)

ITEM(I) - Item code number

CLOS(I) - Distance ray travels through item

CNORMI(I) - Normal distance through item from entrance point

CANGI(I) - Angle between normal vector and ray at entrance point

KSPAC(I) - Code for air space following item

SLOS(I) - Distance ray travels through air space

IH - Horizontal matrix position of grid cell

IV - Vertical matrix position of grid cell

N - Cumulative number of items

Figure 31. Ray Data Lines of GRID Output on FORTRAN Unit 1 (2 components per line)

1-7	8-14	15-23	24-32	33-35	36-43	44-51	52	53	54-59	60	61	62-67	68-80
HCENTR	VCENTR	H	V	NCOMP	DFIRST	DLAST		'A'	A		'E'	E	

FORMAT (2F7.1,2F9.3,I3,2F8.2,1X,1HA,F6.1,1X,1HE,F6.1)(2F7.2,F9.1,2F9.1,I3,2F8.1,'A',F6.1,'E',F6.1)

HCENTR - Horizontal center coordinate of grid cell in view plane

VECENTR - Vertical center coordinate of grid cell in view plane

H - Actual horizontal coordinate in view plane

V - Actual vertical coordinate in view plane

NCOMP - Number of components hit

DFIRST - Distance from first contact to view plane

DLAST - Distance from last contact to view plane

A - Azimuth angle in degrees

E - Elevation angle in degrees

Figure 32. Cell Identification Line GRID Output on FORTRAN Unit 1 (3 components per line)

1-4	5-11	12-16	17-19	20-26	27-52	53-78	79-80
ITEM(I)	CLOS(I)	CANGI(I)	KSPAC(I)	SLOS(I)	SAME AS COLS 1-26	SAME AS COLS 1-26	

FORMAT (3(I4,F7.2,F5.1,I3,F7.2)) (3(I4,F7.1,F5.1,I3,F7.1))

ITEM(I) - Item code number

CLOS(I) - Distance ray travels through item

CANGI(I) - Angle between normal vector and ray at entrance point

KSPAC(I) - Code for air space following item

SLOS(I) - Distance ray travels through air space

Figure 33. Ray Data Line of GRID Output on FORTRAN Unit 1 (3 components per line)

1-6	7-77	78-80
' 999.9'		'END'

Figure 34. Last Line for Each View of GRID Output on FORTRAN Unit 1 (for all forms)

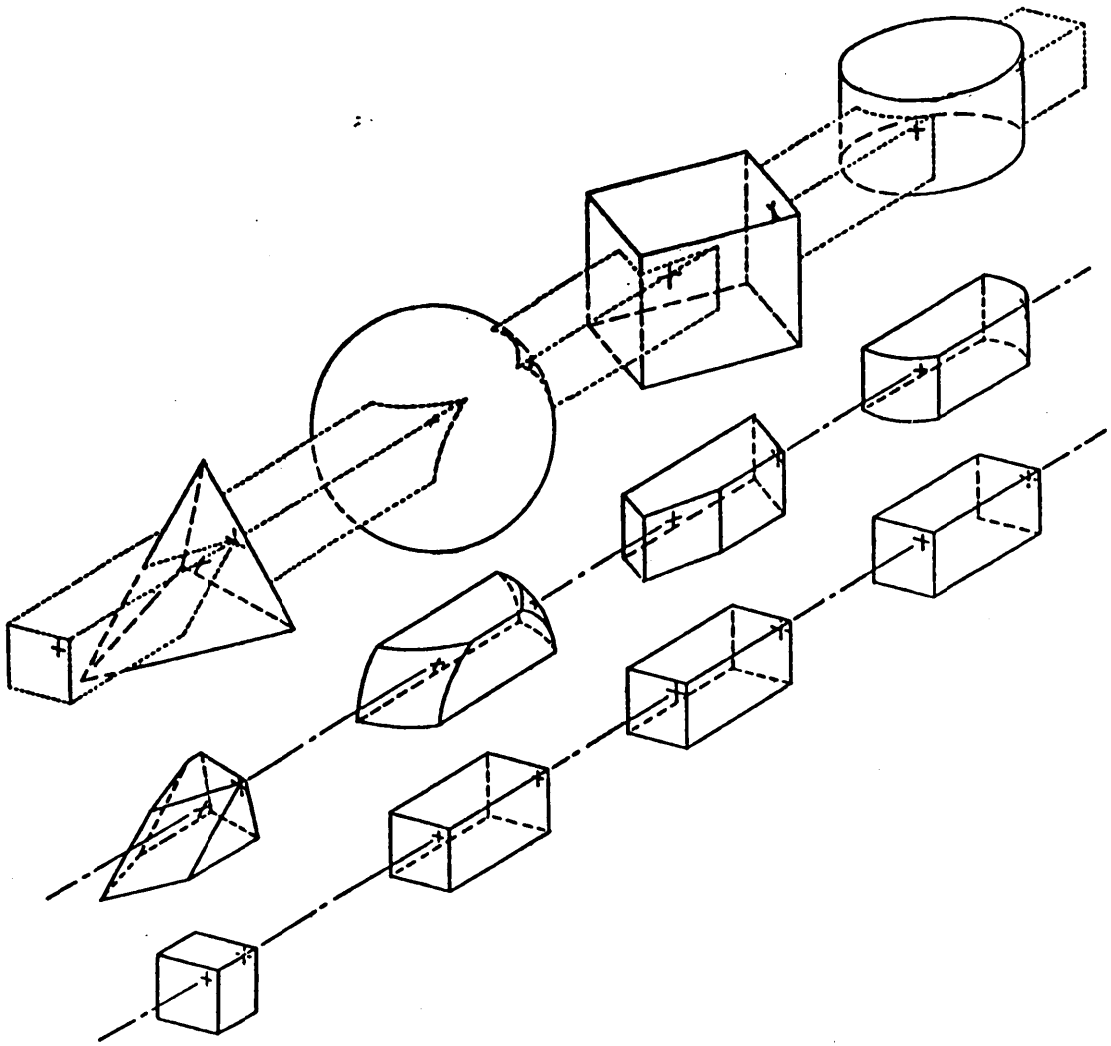


Figure 35. Visualization of the Simulation of the Intersection of a Grid Cell with Target Components

computed volume and the estimated density data of the Item Density Table. The moments of inertia, center of gravity and total vehicle mass are calculated for axes passing through x=0, y=0 and z=0. The moments of inertia are then computed by using the Parallel Axis Theorem for a set of axes centered at the coordinates of the corresponding computed center of gravity. The final estimate of the moments of inertia, center of gravity, component masses and total vehicle mass are the computed averages of all three views. Figures 36 through 38 describe the input for the MOMENT option.

If the message "**** ERROR IN MOMENT **** ... NUMBER OF ITEMS (number) EXCEEDS ARRAY SIZE (number)" is printed, the variable MXITEM and the arrays ITEMS, CINF and CWT in the MOMENT subroutine would have to be changed to be equal to or greater than the number after "NUMBER OF ITEMS."

Table XXVII is the output generated using the COM-GEOM description in Table I and the MOMENT option data located in Figure 39. The portion of the output with header line "ENTER MOMENT" describes the Enclosing RPP of the target. The first line under "XMIN...ZMIN" is the Enclosing RPP of the target. The second line is the RPP expanded so that an even number of grid cells on each face is established. The next three portions in the printout contains the data generated by the MOMENT option for the front, side and top views. The last two portions of the printout contain averages of the three views. The portion beginning with the line "ITEM...DESCRIPTION" supplies an averaged weight for each item (component) of the target. The item code number, density and an alphanumeric description of each component is also supplied. The last portion contains an averaged center of gravity, moments of inertia, mass and volumes for the three views.

E. PICTUR Option

The PICTUR option generates a line drawing (may be plotted on a Calcomp plotter) of the COM-GEOM description as it appears from any azimuth and elevation combination. Lines not visible from the selected aspect angles are not drawn. The plot drawn can be either isometric or perspective. Selected regions or cross-sections of the COM-GEOM description can be plotted. The main purpose of the PICTUR option is to generate a visual representation of the COM-GEOM description for reports and presentations but it can also be used to check the location and shape of the described components. Figures 40 through 44 describe the input for the PICTUR option.

The plot generated by the PICTUR option is obtained by basically a search technique. The grid is constructed for the selected view of the COM-GEOM description with the cell size specified. An initial scan is made by dividing the horizontal and vertical lengths of the grid into approximately 10 segments each. Rays are traced through the

1-2	3-4	5-6	7-8	9-10	11-12	13-14	15	16	17-20	31-40	41-50	51-80
CELLUN	DENUNM	DENUNV	MOMUNM	MOMUNA	AREAUN	VOLUN	IRPP	ICENTR	NVIEW	CELBIZ	MAXERR	

FORMAT (7A2,2I1,I4,F10.0,10X,I10)

(Allowable codes for following options to denote units are: IN = inches, FT = feet, CM = centimeters, M = meters, MM = millimeters, LB = pounds, SL = slugs, GM = grams, KG = kilograms)

CELLUN - Specify code to denote units in which the COM-GEOM description is described (Default = IN)

DENUNM - Specify code to denote mass unit used in the Item Density Table (Default = GM)

DENUNV - Specify code to denote volume unit used in the Item Density Table (Default = CM)

MOMUNM - Specify code to denote mass units in which to print Moments of Intertia (Default = LB)

MOMUNA - Specify code to denote area units in which to print Moments of Inertia (Default = FT)

AREAUN - Specify code to denote units in which to print Areas (Default = FT)

VOLUN - Specify code to denote units in which to print Volumes (Default = FT)

IRPP - If not zero, read a Target Enclosing RPP card

ICENTR - If zero, rays are traced through a random point in the grid cell. If not zero, rays are traced through the center of the grid cell

NVIEW - Specify the number of views (Deafult = 3)

1 - Front view only
2 - Front and side views
3 - Front, side and top views

(Azimuth and elevation angles for the front, side and top are 0°, 0°; 90°, 0° and 0°, 90°, respectively)

Figure 36. Control Card for MOMENT Option

CELSIZ - Specify grid cell size (Default = 1)

MAXERR - Specify the maximum number of overlap errors that will be tolerated for each view (Default = 10)

Figure 36. Control Card for MOMENT Option (continued)

1-10	11-20	21-30	31-40	41-50	51-60	61-80
XMIN	XMAX	YMIN	YMAX	ZMIN	ZMAX	

FORMAT (6F10.0)

The minimum (min) and maximum (max) values of the x, y, and z coordinates which bound the rectangular parallelepiped that encloses the COM-GEOM description (Default is the computed Enclosing RPP located at LENRPP in ASTER)

Figure 37. Target Enclosing RPP Card for MOMENT Option (Optional, read only if IRPP of the Control Card is not zero)

1-10	11-20	21-30	31-70	71-80
I	DEN		CARD	

FORMAT (I10,F10.3,10X,4A10)

I - Specify an item code number used in the Region Identification Table

DEN - Specify a density for this item

CARD - Alphanumeric information for this item

Repeat card until all item code numbers used in the Region Identification Table are specified. A blank card signals the end of the Item Density Table.

Figure 38. Item Density Table for MOMENT Option

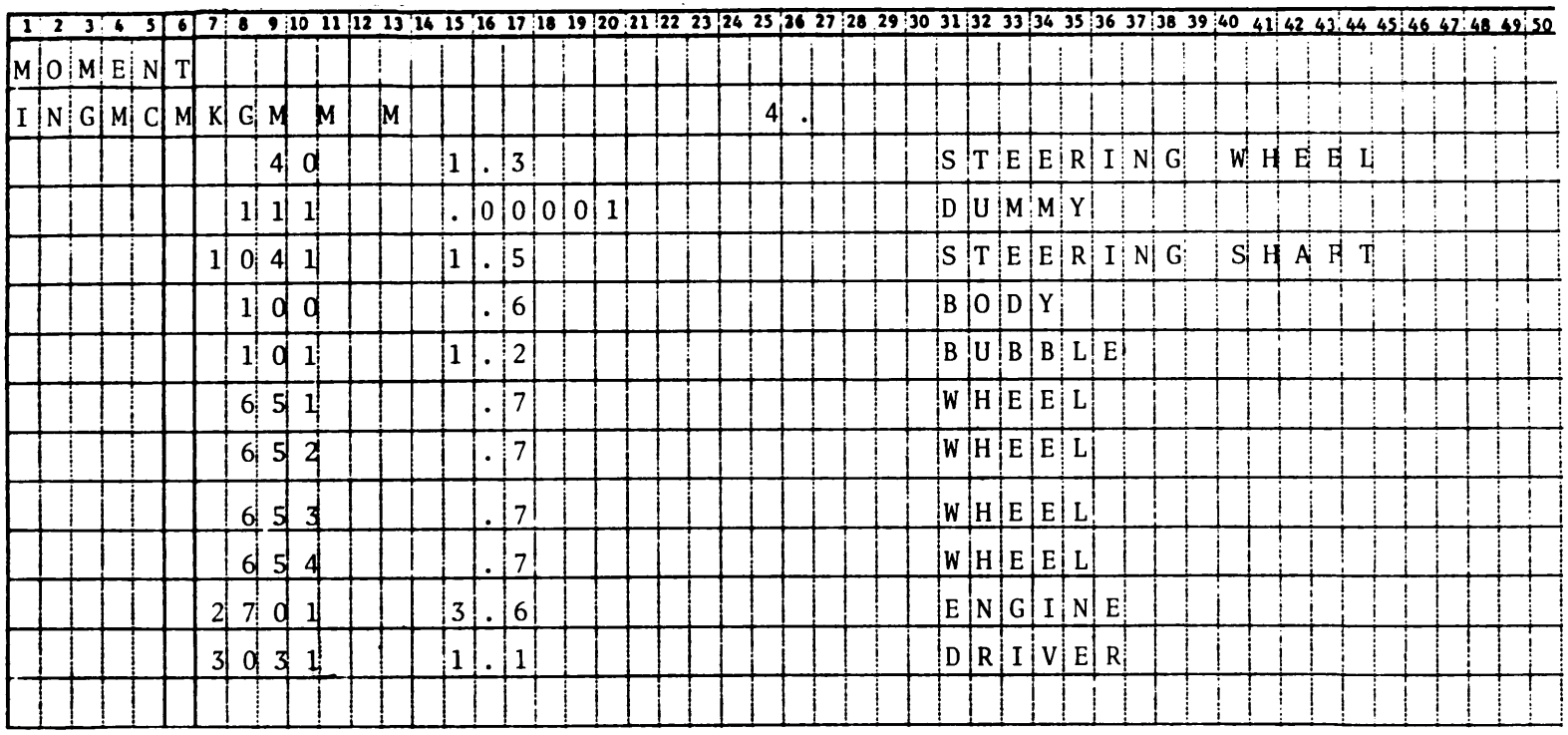


Figure 39. Sample Input for MOMENT Option

Table XXVII. Sample Output for MOMENT Option
(Compressed for Display)

```
ENTER MOMENT

TARGET MINIMUM AND MAXIMUM
      XMIN       XMAX       YMIN       YMAX       ZMIN       ZMAX
   -100.00     100.00     -36.00      36.00        .00      63.00
   -100.00     104.00     -36.00      40.00        .00      64.00

  X LENGTH  Y LENGTH  Z LENGTH
    204.00     76.00     64.00

    NUMBER     NUMBER     NUMBER
   X CELLS    Y CELLS    Z CELLS
        51         19         16

CELL SIZE IS    4.0 X    4.0 IN.

AZIMUTH =      0.0      ELEVATION =      0.0

NUMBER OF RAYS        304

DEPTH      IS PARALLEL TO THE X AXIS
HORIZONTAL IS PARALLEL TO THE Y AXIS
VERTICAL   IS PARALLEL TO THE Z AXIS

CENTER OF GRAVITY
    DEPTH      (X)     -32.5746 IN.
    HORIZONTAL (Y)       -.9878 IN.
    VERTICAL   (Z)      28.0395 IN.

MOMENT OF INERTIA ABOUT DEPTH      CG (X)        62.2224 KG.-M .**2
MOMENT OF INERTIA ABOUT HORIZONTAL CG (Y)       450.5963 KG.-M .**2
MOMENT OF INERTIA ABOUT VERTICAL   CG (Z)       472.7296 KG.-M .**2

TOTAL MASS   =      2822.6764 KG.

COMPONENT VOLUME =          2.3037 CU.M .
SPACE     VOLUME =          5.6071 CU.M .
TOTAL     VOLUME =          7.9108 CU.M .

TOTAL PRESENTED AREA      =          2.0026 SQ.M .
AREA OF  NORMAL INCIDENCE =          0.0000 SQ.M .     RATIO =  0.0000
AREA NON-NORMAL INCIDENCE =          2.0026 SQ.M .     RATIO =  1.0000

MEAN ANGLE  =   36.66     DEGREES
MEAN COSINE =     .79238  IS   37.59 DEGREES

TIME FOR THIS VIEW     .244 SECONDS
```

Table XXVII. Sample Output for MOMENT Option (continued)
(Compressed for Display)

```
AZIMUTH =    90.0     ELEVATION =     0.0

NUMBER OF RAYS       816

DEPTH      IS PARALLEL TO THE Y AXIS
HORIZONTAL IS PARALLEL TO THE X AXIS
VERTICAL   IS PARALLEL TO THE Z AXIS

CENTER OF GRAVITY
    DEPTH      (Y)       .0000 IN.
    HORIZONTAL (X)    -32.5645 IN.
    VERTICAL   (Z)     29.0222 IN.

MOMENT OF INERTIA ABOUT DEPTH      CG (Y)       472.6593 KG.-M .**2
MOMENT OF INERTIA ABOUT HORIZONTAL CG (X)        66.5757 KG.-M .**2
MOMENT OF INERTIA ABOUT VERTICAL   CG (Z)       498.1135 KG.-M .**2

TOTAL MASS   =      2881.9787 KG.

COMPONENT VOLUME =          2.3320 CU.M .
SPACE     VOLUME =          5.6910 CU.M .
TOTAL     VOLUME =          8.0230 CU.M .

TOTAL PRESENTED AREA      =          4.8413 SQ.M .
AREA OF  NORMAL INCIDENCE =          3.7884 SQ.M .     RATIO =    .7825
AREA NON-NORMAL INCIDENCE =          1.0529 SQ.M .     RATIO =    .2175

MEAN ANGLE  =   40.53     DEGREES
MEAN COSINE =     .72815  IS   43.27 DEGREES

TIME FOR THIS VIEW     .418 SECONDS


AZIMUTH =     0.0     ELEVATION =    90.0

NUMBER OF RAYS       969

DEPTH      IS PARALLEL TO THE Z AXIS
HORIZONTAL IS PARALLEL TO THE Y AXIS
VERTICAL   IS PARALLEL TO THE X AXIS

CENTER OF GRAVITY
    DEPTH      (Z)     28.6419 IN.
    HORIZONTAL (Y)       .0163 IN.
    VERTICAL   (X)    -33.2005 IN.

MOMENT OF INERTIA ABOUT DEPTH      CG (Z)       469.1217 KG.-M .**2
MOMENT OF INERTIA ABOUT HORIZONTAL CG (Y)       443.9480 KG.-M .**2
MOMENT OF INERTIA ABOUT VERTICAL   CG (X)        67.2209 KG.-M .**2

TOTAL MASS   =      2900.5352 KG.

COMPONENT VOLUME =          2.3258 CU.M .
SPACE     VOLUME =          5.2746 CU.M .
TOTAL     VOLUME =          7.6004 CU.M .

TOTAL PRESENTED AREA      =          8.5161 SQ.M .
AREA OF  NORMAL INCIDENCE =          6.1522 SQ.M .     RATIO =    .7224
AREA NON-NORMAL INCIDENCE =          2.3639 SQ.M .     RATIO =    .2776

MEAN ANGLE  =   47.81     DEGREES
MEAN COSINE =     .65174  IS   49.33 DEGREES

TIME FOR THIS VIEW     .620 SECONDS
```

Table XXVII. Sample Output for MOMENT Option (continued)
(Compressed for Option)

ITEM	DENSITY (GM/CU.CM)	WEIGHT (KG)	DESCRIPTION
40	1.3000	4.48	STEERING WHEEL
100	.6000	893.75	BODY
101	1.2000	39.97	BUBBLE
111	.0000	0.00	DUMMY
651	.7000	39.03	WHEEL
652	.7000	41.58	WHEEL
653	.7000	42.73	WHEEL
654	.7000	43.03	WHEEL
1041	1.5000	10.63	STEERING SHAFT
2701	3.6000	1654.34	ENGINE
3031	1.1000	98.86	DRIVER

```
CENTER OF GRAVITY
    X    -32.7799 IN.
    Y      -.3238 IN.
    Z     28.5679 IN.

MOMENT OF INERTIA ABOUT X CG        65.3397 KG.-M .**2
MOMENT OF INERTIA ABOUT Y CG       455.7346 KG.-M .**2
MOMENT OF INERTIA ABOUT Z CG       479.9883 KG.-M .**2

TOTAL MASS  =      2868.3968 KG.

COMPONENT VOLUME =          2.3205 CU.M .
SPACE     VOLUME =          5.5242 CU.M .
TOTAL     VOLUME =          7.8447 CU.M .

TOTAL TIME FOR MOMENT    1.291 SECONDS

LEAVE MOMENT
```

1-10	11-20	21-30	31-40	41-50	51-60	61-80
NOAA	ITAPE2	NSKFIL	TIMAX	ISTRT	SCELZ	

FORMAT (3I10,F10.0,I10,F10.0,20X)

NOAA - Specify the number of views

ITAPE2 - If not zero, store the points plotted on FORTRAN Unit 2

NSKFIL - Specify the number of files to skip before writing on FORTRAN Unit 2

TIMAX - Specify the maximum time in seconds that is specified for the computer run (required only if ITAPE2 is not zero)

ISTRT - If not zero, this run restarts from a previous run which stopped because of an almost maximum time or exceed "MAXNOD" termination.

SCELZ - If not zero, use a finer initial scan (The value of SCELZ is the minimum cell size tolerated. However, SCELZ must be greater than or equal to 5 * SMESH (SMESH of the View Card, Figure 41))

Figure 40. Control Card for PICTUR Option

1-10	11-20	21-30	31-40	41-45	46-50	51-60	61-70	71-75	76-80
A	E	SMESH	SCALE	SPECTV	IRPP	MAXERR	DEYE	IDLKP	IXSECT

FORMAT (4E10.3,L5,I5,I10,F10.0,2I5)

A - Specify azimuth angle in degrees

E - Specify elevation angle in degrees

SMESH - Specify grid cell size for plotting (Default = .25)

SCALE - Specify scale for plotting on one inch of graph (Default = 10.0)

SPECTV - If "T", plot a perspective picture

IRPP - If not zero, read a Target Enclosing RPP card

MAXERR - Specify the maximum errors allowed per view (Default = 25)

DEYE - Specify the distance the eye is from the target for perspective picture (Default = the vertical length of the grid divided by .725)

IDLKP - If not zero, plot only selected regions

IXSECT - If less than zero, plot only the portion of the COM-GEOM description not in the box. If greater than zero, plot only the portion of the COM-GEOM description in the box

Figure 41. View Card for PICTUR Option

1-10	11-20	21-30	31-40	41-50	51-60	61-80
XMIN	XMAX	YMIN	YMAX	ZMIN	ZMAX	

FORMAT (6F10.0)

The minimum (min) and maximum (max) values of the x, y, and z coordinates which bound the rectangular parallelepiped that encloses the COM-GEOM description (Default is the computed Enclosing RPP located at LENRPP in ASTER)

Figure 42. Target Enclosing RPP Card for PICTUR Option (Optional, read only if IRPP is zero on View Card)

1-6	7-10	11-15	16-20		71-75	76-80
IDH		NKARD(1)	NKARD(2)	•••	NKARD(13)	NKARD(14)

FORMAT (A6,4X,14A5)

IDH - If "KEEP", the regions are those to be plotted. If "DELETE", the regions listed are those not to be plotted. (Default = "KEEP")

NKARD(I) - Specify the regions to be or not to be plotted. Region numbers or code words are allowed. Allowable code words are:

"THRU" - Through, "100 THRU 150" means regions 100 through 150 are to be considered.

"END" - Last region number, "100 THRU END" means regions 100 through the last region are to be considered.

Repeat as many times as needed to list all of the regions. A blank card is needed to signal end of the list.

Figure 43. Delete Selected Regions Card for PICTUR Option (Optional, read only if IDLKP of View Card is not zero)

1-10	11-20	21-30	31-40	41-50	51-60	61-80
P(1)	P(2)	P(3)	V(1,1)	V(2,1)	V(3,1)	
V(1,2)	V(2,2)	V(3,2)	V(1,3)	V(2,3)	V(3,3)	

FORMAT (6F10.0)

P(I) - Specify the vertex of the box.

V(I,I) - Specify the vectors defining the length, width and depth of the box.

Figure 44. Cross Section Cards for PICTUR Option (Optional, read only if IXSECT of View Card is not zero)

corners of each of the segments from starting points located outside the COM-GEOM description to the first surface of the COM-GEOM description encountered. Adjacent horizontal rays are compared to determine if they intersect the same first surfaces. If two different surfaces are encountered by the two adjacent rays, a ray is traced halfway between the two adjacent rays. Each set of adjacent rays is compared again to locate which side has two different surfaces. A ray is traced halfway between the two rays which have the two different surfaces and compared. This process is repeated until the distance between adjacent rays is equal to the grid cell size (SMESH). The data associated with grid cell is then stored in an array (MA). Figure 45 depicts the procedure used by the Inital Scan of the PICTUR option.

The sample target is projected onto a grid in Figure 45. This grid is divided into 11 segments across and 11 segments down. Rays are traced through the corners of each of the segments from starting points located outside the sample target to the first surface of the sample target. Rays are traced through points 0,0 and 0,67 and compared to determine if they intersect the same first surfaces. They both miss the target so a ray through point 0,134 is traced and compared with the ray through point 0,67. The initial scan continues in the same manner until it reaches point 21,335. The ray traced through point 21,268 misses the target but the ray traced through point 21,335 hits a surface indicating a line is located between them. The area with the loosely spaced dots in Figure 45 depicts the next portion of the initial scan procedure. A ray is traced through point 21,301 which is located approximately halfway between points 21,268 and 21,335. The rays traced through points 21,301 and 21,335 hits the same first surface so another ray is traced through point 21,284 which is located approximately halfway between points 21,260 and 21,301. This procedure is repeated until the line to be plotted is located within one grid cell length between points 21,271 and 21,272. The area containing packed dots in Figure 45 depicts the grid cell which is stored. Rays are first traced through points 22,271 and 22,272 then the first surfaces (identified by region, solid and surface numbers) encountered for each of the four corners of the grid cell, the location (21,271) of the upper left corner of the grid cell and a flag indicating the sides of the grid cell crossed by lines are stored. The initial scan continues until the whole grid has been covered.

After the initial scan, the grid cell data stored in array MA is accessed and used to compute the starting point (node) for a plotted line approximating the line located between two surfaces. The side of the grid cell intersecting the plotted line determines which adjacent grid cell will be computed next. If the adjacent grid cell has not been previously referenced, rays are traced through the two corners which haven't previously been computed. The remaining side of the adjacent grid cell which intersects the plotted line is determined. The plotted line is computed from the midpoint of the side where the plotted line enters the adjacent grid cell to the midpoint of the side where the plotted line leaves the adjacent grid cell. Adjacent grid

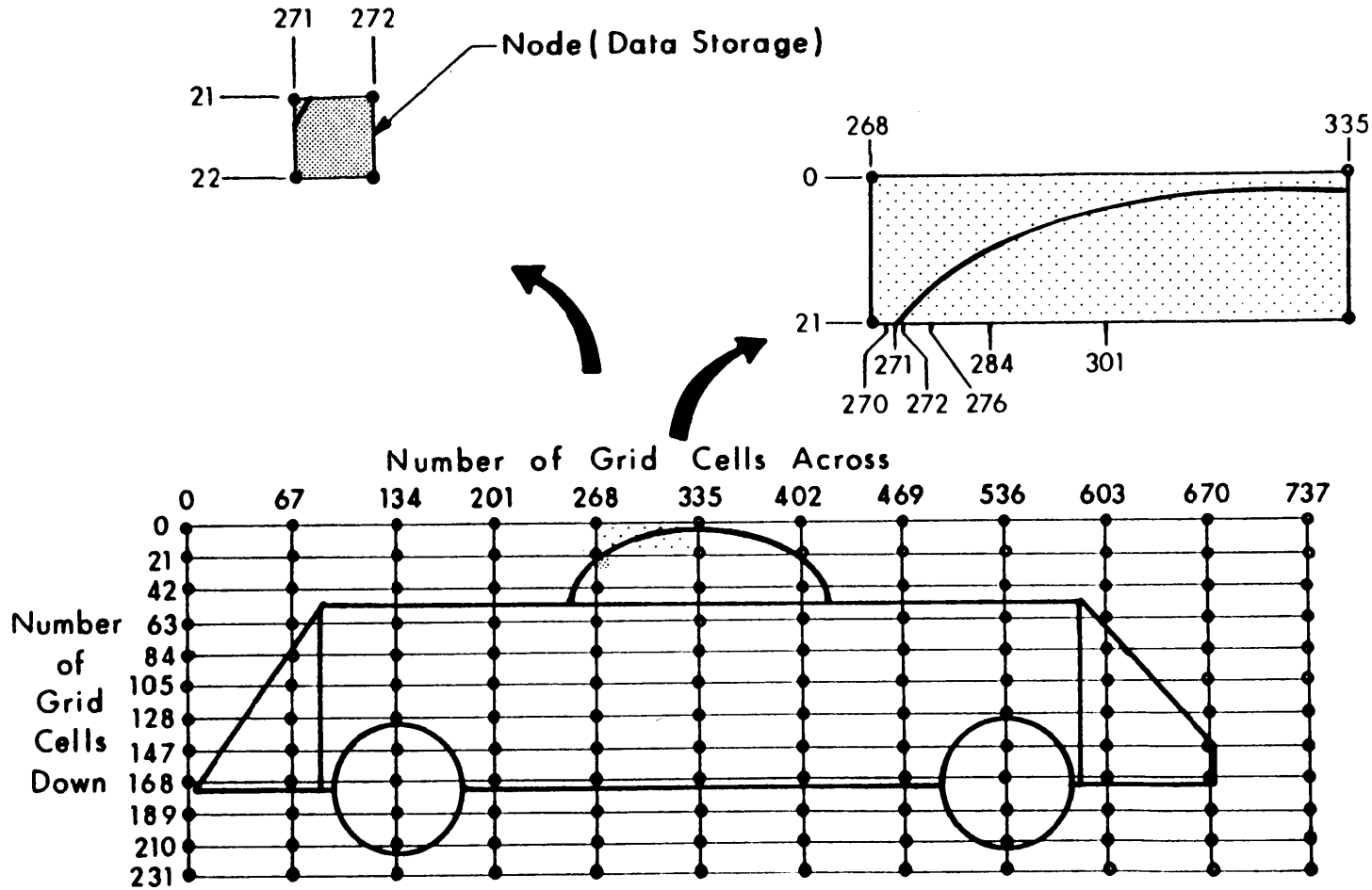


Figure 45. The Initial Scan of PICTUR Option

cells are computed until the plotted line intersects a grid cell previously computed. If a grid cell has more than two sides intersected by lines, the data associated with it is stored. This grid cell data is used as a starting point later. Figure 46 depicts the method of computing the plot of the COM-GEOM description.

Plotting a line drawing portrayed in Figure 46 begins at a grid cell stored in MA with the point 58,81 in the upper left hand corner. The adjacent grid cell with point 57,81 in the lower left hand corner is located above cell 58,81 is then computed because the line between the surfaces intersects the top side of cell 58,81. Rays are traced through points 57,81 and 57,82 of the adjacent grid cell 57,81. The line between the surfaces passes through the right side of the grid cell 57,81. The plotted line is then drawn from the midpoint of the line between points 58,51 and 58,82 to the midpoint of the line between points 58,82 and 57,82. Adjacent grid cell 57,82 is then done, then 55,82, etc. A continuous line is plotted until it intersects a grid cell previously stored in array MA. Grid cell 53,83 has more than two sides intersected by lines, so the data associated with it is stored in array MA.

If the message "NUMBER OF NODES.GT.(value of MAXNOD) - STOP" is printed, the variable MAXNOD and the array MA must be increased.

Table XXVIII is the printout generated by the PICTUR option using the COM-GEOM description listed in Table I and the input for the PICTUR option listed in Figure 47. The section labeled A in Table XXVIII contains information on the Enclosing RPP of the COM-GEOM description. The section labeled B describes the view plane, starting points of the rays, and cell size and the scale for the plot. "HORIZONTAL" and "VERTICAL" are the horizontal and vertical lengths of the grid in the view plane. "MESH SIZE" is the grid cell size. "SCALE" is the number of target units per inch of plotter paper. The portion of the printout labeled C describes the grid in the view plane. The coordinates of the four corners of the grid are specified in the actual x, y and z coordinates of the COM-GEOM description. "DIRECTION OF RAYS" is the normalize vector parallel to the rays traced through the target. "DIRECTION LEFT TO RIGHT" and DIRECTION UP TO DOWN" are the vectors which are parallel to the viewing plane whose length is equal to the grid cell size. "MESH ACROSS" and "MESH DOWN" are the number of grid cells in the horizontal and vertical direction of the grid. The portion labeled D indicates the amount of rays traced and the number of starting points (NODES) stored as a result of the initial scan. The portion labeled E describes the plot. "HORIZONTAL PAGE" and "VERTICAL PAGE" describes the size of the plot (inches). The portion of the printout labeled F indicates the number of rays traced for this view and the amount of starting points (NODES) stored. Note that 25 more starting points were located in the first view of the sample run after initial scan. Figure 48 is the plot for this view of the PICTUR option. The section labeled G is printed when Columns 75 through 80 (IXSECT) of the View card for the PICTUR

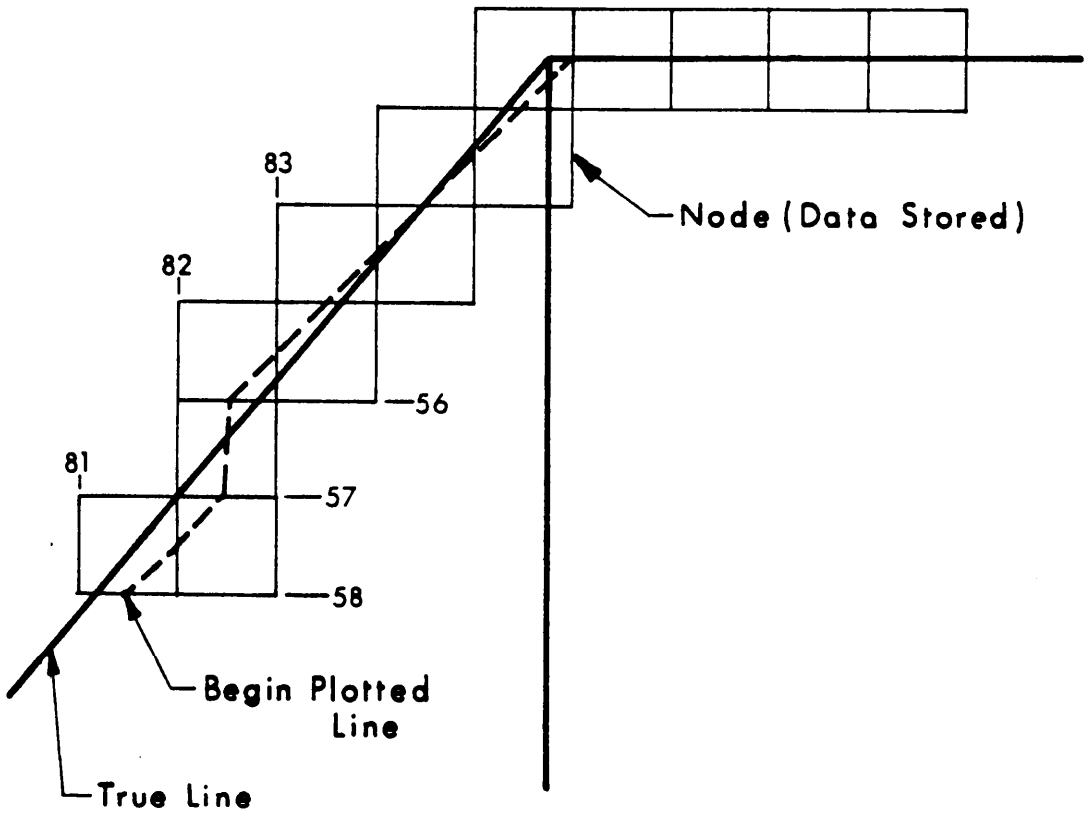


Figure 46. The PICTUR Option Method of Computing Plot Points

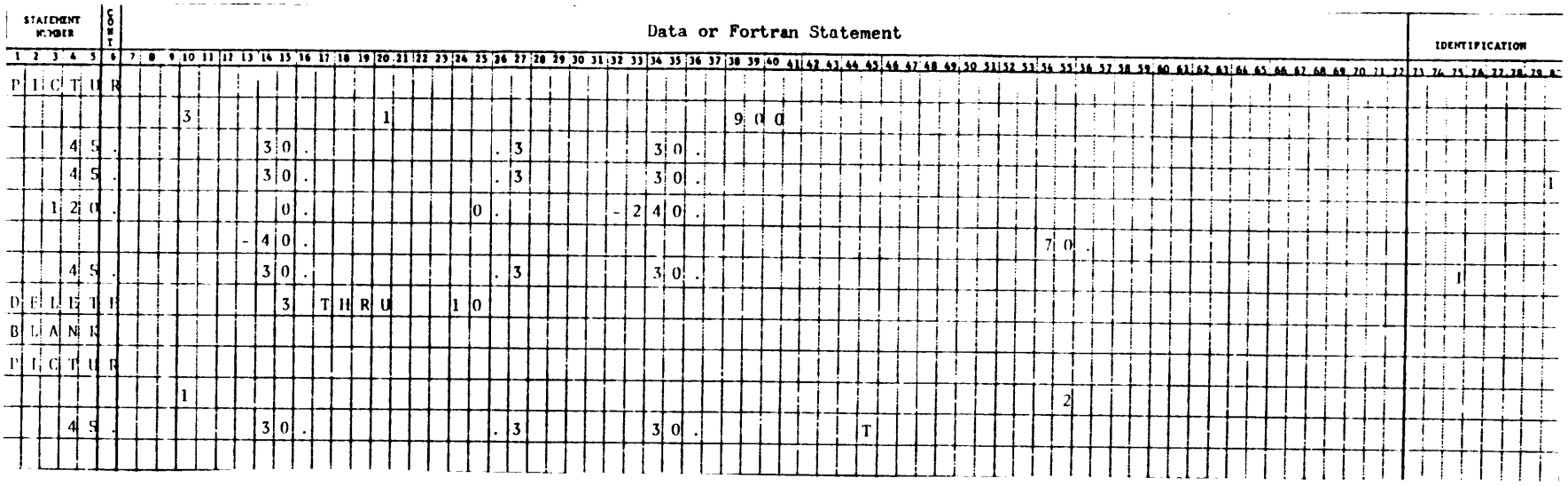


Figure 47. Sample Input for PICTUR Option

Table XXVIII. Sample Output for PICTUR Option
(Compressed for Display)

```
ENTER GRAPHICS PACKAGE

NUMBER OF VIEWS FOR PICTUR     3

WRITE PLOT POINTS ON TAPE 2

NUMBER OF FILES SKIPPED     0

MAXIMUM TIME FOR PICTUR     900.00 SECONDS


                          X          Y          Z
A  TARGET MINIMUM      -100.000    -36.000      .000
   TARGET MAXIMUM       100.000     36.000    63.000
   TARGET CENTER          0.000      0.000    31.500
   TARGET DIMENSIONS    200.000     72.000    63.000

   AZIMUTH               45.000
   ELEVATION             30.000
   HORIZONTAL           193.833
   VERTICAL             152.226
B  BACK OFF DISTANCE    119.000
   TARGET CENTER          0.000      0.000    31.500
   MESH SIZE               .300
   SCALE                 30.000

   UPPER LEFT  CORNER     114.4926   -22.5680   156.9158
   UPPER RIGHT CORNER     -22.5680   114.4926   156.9158
   LOWER LEFT  CORNER     168.3127    31.2520    25.0842
   LOWER RIGHT CORNER      31.2520   168.3127    25.0842
C  DIRECTION OF RAYS       -.6124     -.6124     -.5000
   DIRECTION LEFT TO RIGHT -.2121      .2121      0.0000  WITH MAGNITUDE   .3000
   DIRECTION UP TO DOWN     .1061      .1061     -.2598  WITH MAGNITUDE   .3000
   MESH ACROSS               646
   MESH DOWN                 507

OPTION SET TO WRITE PLOT POINTS ON TAPE 2 FOR FILE NUMBER     1
SAMPLE INPUT FOR GIFT                                              10/30/78

   END OF INITIAL SCAN
D  NUMBER OF RAYS      393
   NUMBER OF NODES      36

TIME FOR INITIAL SCAN       .156 SECONDS

   HORIZONTAL LENGTH  193.83
E  HORIZONTAL PAGE      6.46
   VERTICAL LENGTH    152.23
   VERTICAL PAGE        5.07
   SCALE IS 1.0 IN. =  30.00 UNITS

   END OF VIEW
F  NUMBER OF RAYS     8699
   NUMBER OF POINTS   1995
   MAXIMUM NODES        61


TIME FOR VIEW      4.778 SECONDS
```

Table XXVIII. Sample Output for PICTUR Option (continued)
(Compressed for Display)

```
OPTION SET TO CROSS SECTION TARGET

G  CROSS SECTIONAL BOX IS
       120.0000    0.0000     0.0000 -240.0000    0.0000    0.0000
         0.0000  -40.0000     0.0000    0.0000    0.0000   70.0000

THE FOLLOWING REGIONS NOT NEEDED FOR X-SECTION
    8   10   12   16   18

                          X          Y          Z
TARGET MINIMUM       -100.000   -36.000      .000
TARGET MAXIMUM        100.000    36.000    63.000
TARGET CENTER           0.000     0.000    31.500
TARGET DIMENSIONS     200.000    72.000    63.000

AZIMUTH                45.000
ELEVATION              30.000
HORIZONTAL            193.833
VERTICAL              152.226
BACK OFF DISTANCE     119.000
TARGET CENTER           0.000     0.000    31.500
MESH SIZE                .300
SCALE                  30.000

UPPER LEFT  CORNER          114.4926   -22.5680   156.9158
UPPER RIGHT CORNER          -22.5680   114.4926   156.9158
LOWER LEFT  CORNER          168.3127    31.2520    25.0842
LOWER RIGHT CORNER           31.2520   168.3127    25.0842
DIRECTION OF RAYS             -.6124     -.6124     -.5000
DIRECTION LEFT TO RIGHT       -.2121      .2121     0.0000  WITH MAGNITUDE   .3000
DIRECTION UP TO DOWN           .1061      .1061     -.2598  WITH MAGNITUDE   .3000
MESH ACROSS                     646
MESH DOWN                       507

OPTION SET TO WRITE PLOT POINTS ON TAPE 2 FOR FILE NUMBER    2
SAMPLE INPUT FOR GIFT                                              10/30/78

 ND OF INITIAL SCAN
NUMBER OF RAYS      529
NUMBER OF NODES      62

TIME FOR INITIAL SCAN       .339 SECONDS

HORIZONTAL LENGTH  193.83
HORIZONTAL PAGE      6.46
VERTICAL LENGTH    152.23
VERTICAL PAGE        5.07
SCALE IS 1.0 IN. =  30.00 UNITS

END OF VIEW
NUMBER OF RAYS     14451
NUMBER OF POINTS    3250
MAXIMUM NODES        117


TIME FOR VIEW     11.880 SECONDS
```

Table XXVIII. Sample Output for PICTUR Option (continued)
(Compressed for Display)

```
H  OPTION SET TO DELETE SELECTED REGIONS

                        DELETE REGIONS
              3 THRU   10

                          X          Y          Z
TARGET MINIMUM        -100.000    -36.000      .000
TARGET MAXIMUM         100.000     36.000    63.000
TARGET CENTER            0.000      0.000    31.500
TARGET DIMENSIONS      200.000     72.000    63.000

AZIMUTH                 45.000
ELEVATION               30.000
HORIZONTAL             193.833
VERTICAL               152.226
BACK OFF DISTANCE      119.000
TARGET CENTER            0.000      0.000    31.500
MESH SIZE                 .300
SCALE                   30.000

UPPER LEFT  CORNER          114.4926    -22.5680    156.9158
UPPER RIGHT CORNER          -22.5680    114.4926    156.9158
LOWER LEFT  CORNER          168.3127     31.2520     25.0842
LOWER RIGHT CORNER           31.2520    168.3127     25.0842
DIRECTION OF RAYS            -.6124      -.6124      -.5000
DIRECTION LEFT TO RIGHT      -.2121       .2121       0.0000  WITH MAGNITUDE   .3000
DIRECTION UP TO DOWN          .1061       .1061      -.2598  WITH MAGNITUDE   .3000
MESH ACROSS                    646
MESH DOWN                      507

OPTION SET TO WRITE PLOT POINTS ON TAPE 2 FOR FILE NUMBER    3
SAMPLE INPUT FOR GIFT                                              10/30/78

 NO OF INITIAL SCAN
NUMBER OF RAYS      335
NUMBER OF NODES      33

TIME FOR INITIAL SCAN       .160 SECONDS

HORIZONTAL LENGTH  193.83
HORIZONTAL PAGE      6.46
VERTICAL LENGTH    152.23
VERTICAL PAGE        5.07
SCALE IS 1.0 IN. =  30.00 UNITS

END OF VIEW
NUMBER OF RAYS     8301
NUMBER OF POINTS   1559
MAXIMUM NODES        88


TIME FOR VIEW      5.851 SECONDS


TIME FOR GRAPHICS     22.519 SECONDS

LEAVE GRAPHICS PACKAGE
```

Table XXVIII. Sample Output for PICTUR Option (continued)
(Compressed for Display)

```
 ENTER GRAPHICS PACKAGE

 NUMBER OF VIEWS FOR PICTUR     1

 OPTION SET TO USE FINE SCAN

I HORZ/VERT DIST OF SMALLEST REGION    14.1421    15.7313
  HORZ/VERT CELL SIZE                   7.0711     7.8657
  HORZ/VERT NUMBER OF CELLS                 27         19

                              X          Y          Z
 TARGET MINIMUM          -100.000   -36.000      .000
 TARGET MAXIMUM           100.000    36.000    63.000
 TARGET CENTER              0.000     0.000    31.500
 TARGET DIMENSIONS        200.000    72.000    63.000

 AZIMUTH                   45.000
 ELEVATION                 30.000
 HORIZONTAL               193.833
 VERTICAL                 152.226
 BACK OFF DISTANCE        119.000
 TARGET CENTER              0.000     0.000    31.500
 MESH SIZE                   .300
 SCALE                     30.000

 OPTION SET FOR PERSPECTIVE PICTURE
 SIZE OF VERTICAL IMAGE              152.226
J DISTANCE FROM TARGET TO EYE        209.967
 CENTER OF TARGET TO EYE             308.967
 CENTER OF TARGET TO IMAGE PLANE     518.934

 UPPER LEFT  CORNER          359.4013   222.3406   356.8829
 UPPER RIGHT CORNER          222.3406   359.4013   356.8829
 LOWER LEFT  CORNER          413.2213   276.1607   225.0512
 LOWER RIGHT CORNER          276.1607   413.2213   225.0512
 DIRECTION OF RAYS             -.6124     -.6124     -.5000
 DIRECTION LEFT TO RIGHT       -.2121      .2121     0.0000  WITH MAGNITUDE   .3000
 DIRECTION UP TO DOWN           .1061      .1061     -.2598  WITH MAGNITUDE   .3000
 MESH ACROSS                     646
 MESH DOWN                       507

 END OF INITIAL SCAN
 NUMBER OF RAYS     855
 NUMBER OF NODES     44

 TIME FOR INITIAL SCAN      .213 SECONDS

 HORIZONTAL LENGTH  193.83
 HORIZONTAL PAGE      6.46
 VERTICAL LENGTH    152.23
 VERTICAL PAGE        5.07
 SCALE IS 1.0 IN. =  30.00 UNITS

 END OF VIEW
 NUMBER OF RAYS     6431
 NUMBER OF POINTS   1208
 MAXIMUM NODES        86

 TIME FOR VIEW     3.152 SECONDS

 TIME FOR GRAPHICS     3.154 SECONDS

 LEAVE GRAPHICS PACKAGE
```

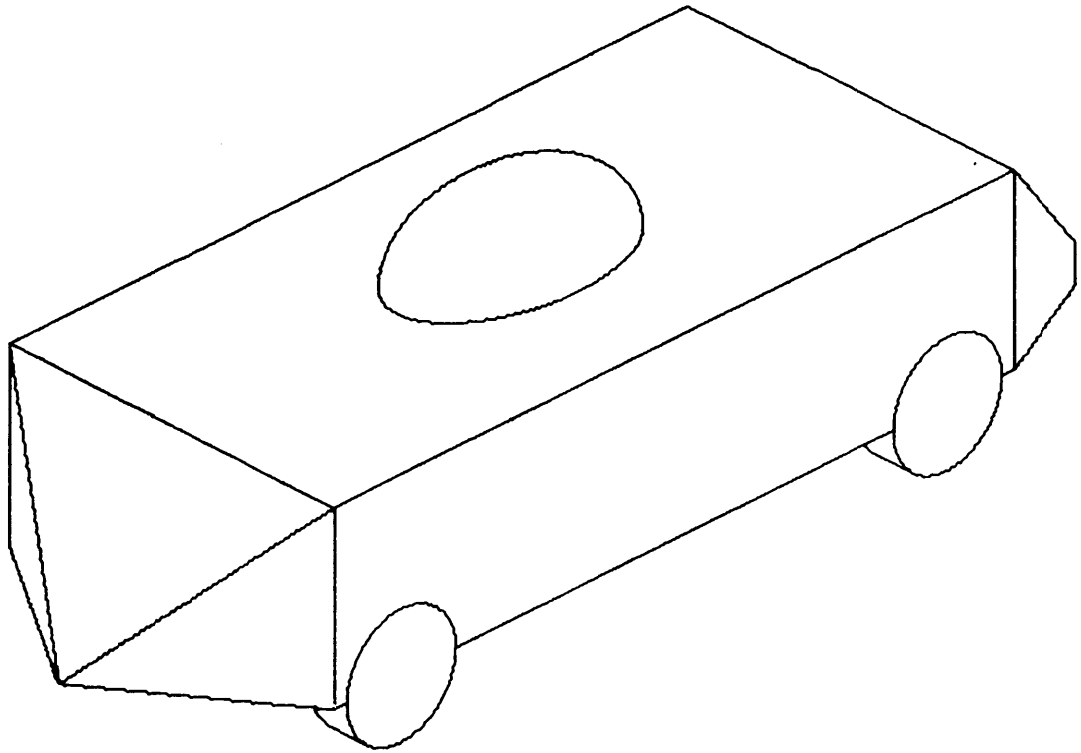


Figure 48. Sample Plot Generated by PICTUR Option (Normal Mode)

option is not zero and the cross section cards are inputted. If the value of IXSECT is greater than zero, those regions whose region RPPs do not overlap the RPP which encompasses the box will be temporarily deleted from the COM-GEOM description. Figure 49 is the plot for the view using the Cross Section option. The section of the printout labeled H is printed when Columns 71 through 75 (IDLKP) of the View card is not zero and a list of selected regions is inputted. Figure 50 is the plot for the view using the Delete Selected Regions option. The section labeled I is printed when Columns 51-60 (SCELZ) of the Control card of the PICTUR option is not equal to zero. The "HORZ/VERT DIST OF SMALLEST REGION" is size of the rectangle in the view plane which encompasses the projection of the smallest region of the COM-GEOM description onto the view plane. The "HORZ/VERT CELL SIZE" is the horizontal and vertical grid cell lengths selected for the initial scan. The selected grid cell lengths for the initial scan is the largest of three values: one-half of the length of each side of the rectangle in the view plane which encompasses the projection of the smallest region onto the view plane, the value of the variable SCELZ or five times the value of grid cell size (SMESH). The option to use fine scan does require more computer run time for the initial scan of the PICTUR option. The section labeled J is printed when a perspective picture is desired. Figure 51 is the plot generated for the view containing the Perspective Picture and Fine-Scan options.

Figures 52 through 56 describe the output generated on FORTRAN Unit 2 when that option is specified in Columns 11-20 of the Control card for PICTUR option. Table XXIX contains an example of the plot data written on FORTRAN Unit 2. If the message "RESTART VALUES STORED ON TAPE 2" is printed, the execution of the PICTUR option can be resumed where it stopped by specifying the number of files to skip given in the message in Columns 21-30 and specifying a non-zero number in Columns 41-50 of the Control card for PICTUR.

F. PLTRPP Option

The PLTRPP option plots the three basic views (front, side and top) of the region RPP equivalents of the COM-GEOM description on the printer. The plotted RPPs are labeled so they can be identified. The PLTRPP option provides a quick method of locating regions and their approximate size. Figures 57 through 60 define the input for the PLTRPP option.

Table XXX is the output generated by the PLTRPP option when the COM-GEOM description in Table I and the PLTRPP data in Figure 61 were used as input. The section of Table XXX labeled A depicts the front view of the region RPPs of the COM-GEOM description of the Sample Target. The rows and columns containing the letter "A" (which forms a rectangle) in the graph of the region RPPs is referenced in the table in the column labeled "SYMBOL" and denotes RPP of Region 1 of the COM-GEOM description. Plotted lines which are common to more than one region RPP will alternate between the two different printer characters which

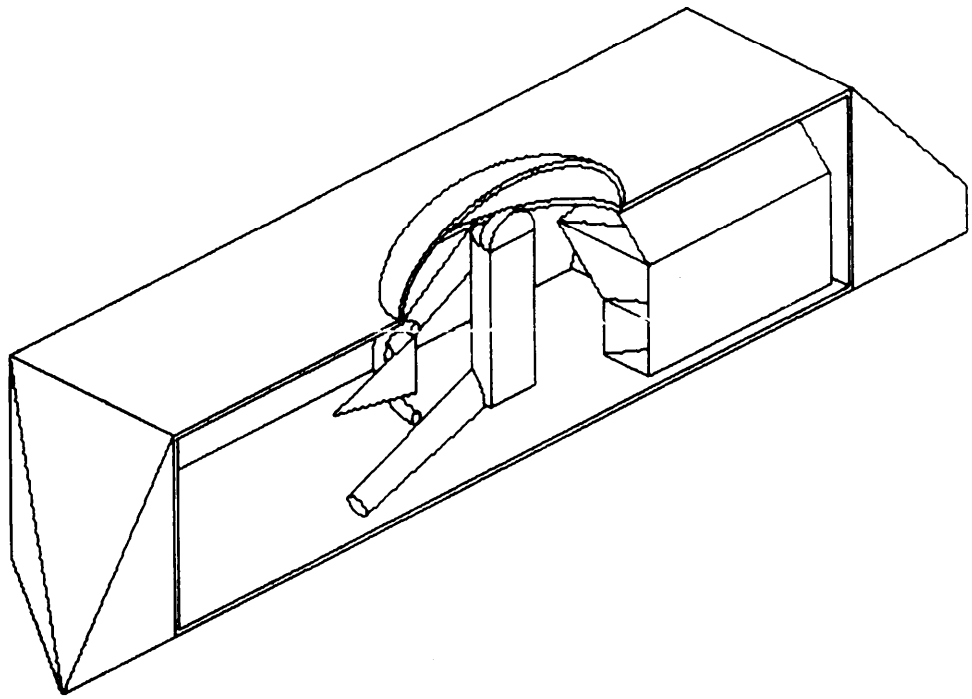
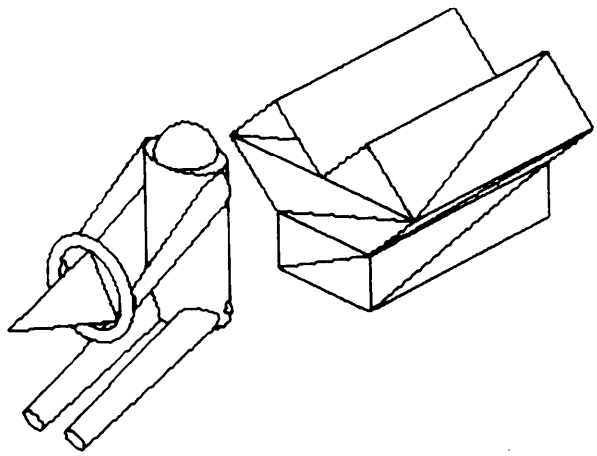


Figure 49. Sample Plot Generated by PICTUR Option Using the Cross Section Option



SAMPLE INPUT FOR GIFT PROGRAM NOV. 30.1973
AZIMUTH 45.0 ELEVATION 30.0
SCALE 0 30.00

Figure 50. Sample Plot Generated by PICTUR Option Using Delete Selected Regions Option

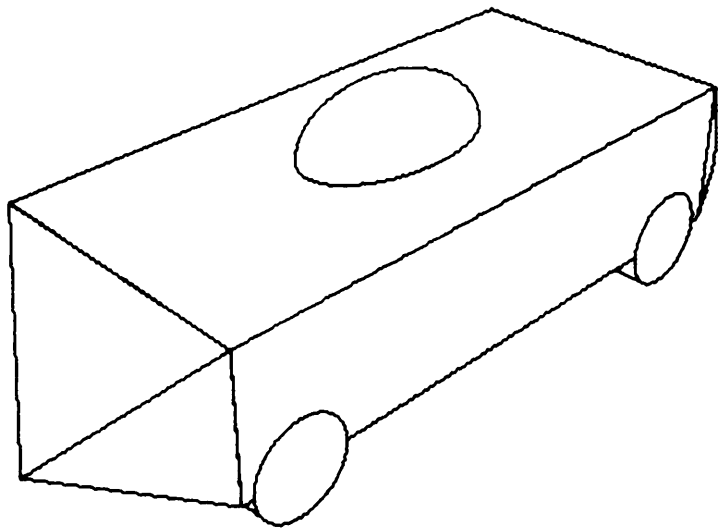


Figure 51. Sample Plot Generated by PICTUR Option Using the Perspective Option

Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Input

```
SAMPLE INPUT FOR GIFT                                                    10/30/78
     45.0000      30.0000     193.8330     152.2261        .3000
          1
     96.9165      76.1131     96.9165      48.8333
          300
    109.6500     122.2261    109.8000     122.3761    110.1000     122.3761
    110.4000     122.6761    110.7000     122.6761    111.0000     122.9761
    111.3000     122.9761    111.6000     123.2761    111.9000     123.2761
    112.2000     123.5761    112.5000     123.5761    112.8000     123.8761
    113.1000     123.8761    113.4000     124.1761    113.7000     124.1761
    114.0000     124.4761    114.3000     124.4761    114.6000     124.7761
    114.9000     124.7761    115.2000     125.0761    115.5000     125.0761
    115.8000     125.3761    116.1000     125.3761    116.4000     125.6761
    116.7000     125.6761    117.0000     125.9761    117.3000     125.9761
    117.6000     126.2761    117.9000     126.2761    118.2000     126.5761
    118.5000     126.5761    118.8000     126.8761    119.1000     126.8761
    119.4000     127.1761    119.7000     127.1761    120.0000     127.4761
    120.3000     127.4761    120.6000     127.7761    120.9000     127.7761
    121.2000     128.0761    121.5000     128.0761    121.8000     128.3761
    122.1000     128.3761    122.4000     128.6761    122.7000     128.6761
    123.0000     128.9761    123.3000     128.9761    123.6000     129.2761
    123.9000     129.2761    124.2000     129.5761    124.8000     129.5761
    125.1000     129.2761    125.4000     129.2761    125.7000     128.9761
    126.0000     128.9761    126.3000     128.6761    126.6000     128.6761
    126.9000     128.3761    127.2000     128.3761    127.5000     128.0761
    127.8000     128.0761    128.1000     127.7761    128.4000     127.7761
    128.7000     127.4761    129.0000     127.4761    129.3000     127.1761
    129.6000     127.1761    129.9000     126.8761    130.2000     126.8761
    130.5000     126.5761    130.8000     126.5761    131.1000     126.2761
    131.4000     126.2761    131.7000     125.9761    132.0000     125.9761
    132.3000     125.6761    132.6000     125.6761    132.9000     125.3761
    133.2000     125.3761    133.5000     125.0761    133.8000     125.0761
    134.1000     124.7761    134.4000     124.7761    134.7000     124.4761
    135.0000     124.4761    135.3000     124.1761    135.6000     124.1761
    135.9000     123.8761    136.2000     123.8761    136.5000     123.5761
    136.8000     123.5761    137.1000     123.2761    137.4000     123.2761
    137.7000     122.9761    138.0000     122.9761    138.3000     122.6761
    138.6000     122.6761    138.9000     122.3761    139.2000     122.3761
    139.5000     122.0761    139.8000     122.0761    140.1000     121.7761
    140.4000     121.7761    140.7000     121.4761    141.0000     121.4761
    141.3000     121.1761    141.6000     121.1761    141.9000     120.8761
    142.2000     120.8761    142.5000     120.5761    142.8000     120.5761
    143.1000     120.2761    143.4000     120.2761    143.7000     119.9761
    144.0000     119.9761    144.3000     119.6761    144.6000     119.6761
    144.9000     119.3761    145.2000     119.3761    145.5000     119.0761
    145.8000     119.0761    146.1000     118.7761    146.4000     118.7761
    146.7000     118.4761    147.0000     118.4761    147.3000     118.1761
    147.6000     118.1761    147.9000     117.8761    148.2000     117.8761
    148.5000     117.5761    148.8000     117.5761    149.1000     117.2761
    149.4000     117.2761    149.7000     116.9761    150.0000     116.9761
    150.3000     116.6761    150.6000     116.6761    150.9000     116.3761
    151.2000     116.3761    151.5000     116.0761    151.8000     116.0761
    152.1000     115.7761    152.4000     115.7761    152.7000     115.4761
    153.0000     115.4761    153.3000     115.1761    153.6000     115.1761
    153.9000     114.8761    154.2000     114.8761    154.5000     114.5761
    154.8000     114.5761    155.1000     114.2761    155.4000     114.2761
    155.7000     113.9761    156.0000     113.9761    156.3000     113.6761
    156.6000     113.6761    156.9000     113.3761    157.2000     113.3761
    157.5000     113.0761    157.8000     113.0761    158.1000     112.7761
    158.4000     112.7761    158.7000     112.4761    159.0000     112.4761
    159.3000     112.1761    159.6000     112.1761    159.9000     111.8761
    160.2000     111.8761    160.5000     111.5761    160.8000     111.5761
```

Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Input (continued)

161.1000	111.2761	161.4000	111.2761	161.7000	110.9761
162.0000	110.9761	162.3000	110.6761	162.6000	110.6761
162.9000	110.3761	163.2000	110.3761	163.5000	110.0761
163.8000	110.0761	164.1000	109.7761	164.4000	109.7761
164.7000	109.4761	165.0000	109.4761	165.3000	109.1761
165.6000	109.1761	165.9000	108.8761	166.2000	108.8761
166.5000	108.5761	166.8000	108.5761	167.1000	108.2761
167.4000	108.2761	167.7000	107.9761	168.0000	107.9761
168.3000	107.6761	168.6000	107.6761	168.9000	107.3761
169.2000	107.3761	169.5000	107.0761	169.8000	107.0761
170.1000	106.7761	170.4000	106.7761	170.7000	106.4761
171.0000	106.4761	171.3000	106.1761	171.6000	106.1761
171.9000	105.8761	172.2000	105.8761	172.5000	105.5761
172.8000	105.5761	173.1000	105.2761	173.4000	105.2761
173.7000	104.9761	174.0000	104.9761	174.3000	104.6761
174.6000	104.6761	174.9000	104.3761	175.2000	104.3761
175.3500	104.2261	175.2000	104.0761	174.9000	104.0761
174.6000	103.7761	174.3000	103.7761	174.0000	103.4761
173.7000	103.4761	173.4000	103.1761	173.1000	103.1761
172.8000	102.8761	172.5000	102.8761	172.2000	102.5761
171.9000	102.5761	171.6000	102.2761	171.3000	102.2761
171.0000	101.9761	170.7000	101.9761	170.4000	101.6761
170.1000	101.6761	169.8000	101.3761	169.5000	101.3761
169.2000	101.0761	168.9000	101.0761	168.6000	100.7761
168.3000	100.7761	168.0000	100.4761	167.7000	100.4761
167.4000	100.1761	167.1000	100.1761	166.8000	99.8761
166.5000	99.8761	166.2000	99.5761	165.9000	99.5761
165.6000	99.2761	165.3000	99.2761	165.0000	98.9761
164.7000	98.9761	164.4000	98.6761	164.1000	98.6761
163.8000	98.3761	163.5000	98.3761	163.2000	98.0761
162.9000	98.0761	162.6000	97.7761	162.3000	97.7761
162.0000	97.4761	161.7000	97.4761	161.4000	97.1761
161.1000	97.1761	160.8000	96.8761	160.5000	96.8761
160.2000	96.5761	159.9000	96.5761	159.6000	96.2761
159.3000	96.2761	159.0000	95.9761	158.7000	95.9761
158.4000	95.6761	158.1000	95.6761	157.8000	95.3761
157.5000	95.3761	157.2000	95.0761	156.9000	95.0761
156.6000	94.7761	156.3000	94.7761	156.0000	94.4761
155.7000	94.4761	155.4000	94.1761	155.1000	94.1761
154.8000	93.8761	154.5000	93.8761	154.2000	93.5761
153.9000	93.5761	153.6000	93.2761	153.3000	93.2761
153.0000	92.9761	152.7000	92.9761	152.4000	92.6761
152.1000	92.6761	151.8000	92.3761	151.5000	92.3761
300					
151.3500	92.2261	151.2000	92.0761	150.9000	92.0761
150.6000	91.7761	150.3000	91.7761	150.0000	91.4761
149.7000	91.4761	149.4000	91.1761	149.1000	91.1761
148.8000	90.8761	148.5000	90.8761	148.2000	90.5761
147.9000	90.5761	147.6000	90.2761	147.3000	90.2761
147.0000	89.9761	146.7000	89.9761	146.4000	89.6761
146.1000	89.6761	145.8000	89.3761	145.5000	89.3761
145.2000	89.0761	144.9000	89.0761	144.6000	88.7761
144.3000	88.7761	144.0000	88.4761	143.7000	88.4761
143.4000	88.1761	143.1000	88.1761	142.8000	87.8761
142.5000	87.8761	142.2000	87.5761	141.9000	87.5761
141.6000	87.2761	141.3000	87.2761	141.0000	86.9761
140.7000	86.9761	140.4000	86.6761	140.1000	86.6761
139.8000	86.3761	139.5000	86.3761	139.2000	86.0761
138.9000	86.0761	138.6000	85.7761	138.3000	85.7761
138.0000	85.4761	137.7000	85.4761	137.4000	85.1761
137.1000	85.1761	136.8000	84.8761	136.5000	84.8761
136.2000	84.5761	135.9000	84.5761	135.6000	84.2761
135.3000	84.2761	135.0000	83.9761	134.7000	83.9761

Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Target (continued)

134.4000	83.6761	134.1000	83.6761	133.8000	83.3761
133.5000	83.3761	133.2000	83.0761	132.9000	83.0761
132.6000	82.7761	132.3000	82.7761	132.0000	82.4761
131.7000	82.4761	131.4000	82.1761	131.1000	82.1761
130.8000	81.8761	130.5000	81.8761	130.2000	81.5761
129.9000	81.5761	129.6000	81.2761	129.3000	81.2761
129.0000	80.9761	128.7000	80.9761	128.4000	80.6761
128.1000	80.6761	127.8000	80.3761	127.5000	80.3761
127.2000	80.0761	126.9000	80.0761	126.6000	79.7761
126.3000	79.7761	126.0000	79.4761	125.7000	79.4761
125.4000	79.1761	125.1000	79.1761	124.8000	78.8761
124.5000	78.8761	124.2000	78.5761	123.9000	78.5761
123.6000	78.2761	123.3000	78.2761	123.0000	77.9761
122.7000	77.9761	122.4000	77.6761	122.1000	77.6761
121.8000	77.3761	121.5000	77.3761	121.2000	77.0761
120.9000	77.0761	120.6000	76.7761	120.3000	76.7761
120.0000	76.4761	119.7000	76.4761	119.4000	76.1761
119.1000	76.1761	118.8000	75.8761	118.5000	75.8761
118.2000	75.5761	117.9000	75.5761	117.6000	75.2761
117.3000	75.2761	117.0000	74.9761	116.7000	74.9761
116.4000	74.6761	116.1000	74.6761	115.8000	74.3761
115.5000	74.3761	115.2000	74.0761	114.9000	74.0761
114.6000	73.7761	114.3000	73.7761	114.0000	73.4761
113.7000	73.4761	113.4000	73.1761	113.1000	73.1761
112.8000	72.8761	112.5000	72.8761	112.2000	72.5761
111.9000	72.5761	111.6000	72.2761	111.3000	72.2761
111.0000	71.9761	110.7000	71.9761	110.4000	71.6761
110.1000	71.6761	109.8000	71.3761	109.5000	71.3761
109.2000	71.0761	108.9000	71.0761	108.6000	70.7761
108.3000	70.7761	108.0000	70.4761	107.7000	70.4761
107.4000	70.1761	107.1000	70.1761	106.8000	69.8761
106.5000	69.8761	106.2000	69.5761	105.9000	69.5761
105.6000	69.2761	105.3000	69.2761	105.0000	68.9761
104.7000	68.9761	104.4000	68.6761	104.1000	68.6761
103.8000	68.3761	103.5000	68.3761	103.2000	68.0761
102.9000	68.0761	102.6000	67.7761	102.3000	67.7761
102.0000	67.4761	101.7000	67.4761	101.4000	67.1761
101.1000	67.1761	100.8000	66.8761	100.5000	66.8761
100.2000	66.5761	99.9000	66.5761	99.6000	66.2761
99.3000	66.2761	99.0000	65.9761	98.7000	65.9761
98.4000	65.6761	98.1000	65.6761	97.8000	65.3761
97.5000	65.3761	97.2000	65.0761	96.9000	65.0761
96.6000	64.7761	96.3000	64.7761	96.0000	64.4761
95.7000	64.4761	95.4000	64.1761	95.1000	64.1761
94.8000	63.8761	94.5000	63.8761	94.2000	63.5761
93.9000	63.5761	93.6000	63.2761	93.3000	63.2761
93.0000	62.9761	92.7000	62.9761	92.4000	62.6761
92.1000	62.6761	91.8000	62.3761	91.5000	62.3761
91.2000	62.0761	90.9000	62.0761	90.6000	61.7761
90.3000	61.7761	90.0000	61.4761	89.7000	61.4761
89.4000	61.1761	89.1000	61.1761	88.8000	60.8761
88.5000	60.8761	88.2000	60.5761	87.9000	60.5761
87.6000	60.2761	87.3000	60.2761	87.0000	59.9761
86.7000	59.9761	86.4000	59.6761	86.1000	59.6761
85.8000	59.3761	85.5000	59.3761	85.2000	59.0761
84.9000	59.0761	84.6000	58.7761	84.3000	58.7761
84.0000	58.4761	83.7000	58.4761	83.4000	58.1761
83.1000	58.1761	82.8000	57.8761	82.5000	57.8761
82.2000	57.5761	81.9000	57.5761	81.6000	57.2761
81.3000	57.2761	81.0000	56.9761	80.7000	56.9761
80.4000	56.6761	80.1000	56.6761	79.8000	56.3761
79.5000	56.3761	79.2000	56.0761	78.9000	56.0761
78.6000	55.7761	78.3000	55.7761	78.0000	55.4761

Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Input (continued)

77.7000	55.4761	77.4000	55.1761	77.1000	55.1761
76.8000	54.8761	76.5000	54.8761	76.2000	54.5761
75.9000	54.5761	75.6000	54.2761	75.3000	54.2761
75.0000	53.9761	74.7000	53.9761	74.4000	53.6761
74.1000	53.6761	73.8000	53.3761	73.5000	53.3761
73.2000	53.0761	72.9000	53.0761	72.6000	52.7761
72.3000	52.7761	72.0000	52.4761	71.7000	52.4761
71.4000	52.1761	71.1000	52.1761	70.8000	51.8761
70.5000	51.8761	70.2000	51.5761	69.9000	51.5761
69.6000	51.2761	69.0000	51.2761	68.7000	51.5761
68.4000	51.5761	68.1000	51.8761	67.8000	51.8761
67.5000	52.1761	67.2000	52.1761	66.9000	52.4761
66.6000	52.4761	66.3000	52.7761	66.0000	52.7761
65.7000	53.0761	65.4000	53.0761	65.1000	53.3761
64.8000	53.3761	64.5000	53.6761	64.2000	53.6761
63.9000	53.9761	63.6000	53.9761	63.3000	54.2761
63.0000	54.2761	62.7000	54.5761	62.4000	54.5761
62.1000	54.8761	61.8000	54.8761	61.6500	55.0261
300					
61.5000	55.1761	61.2000	55.1761	60.9000	55.4761
60.6000	55.4761	60.3000	55.7761	60.0000	55.7761
59.7000	56.0761	59.4000	56.0761	59.1000	56.3761
58.8000	56.3761	58.5000	56.6761	58.2000	56.6761
57.9000	56.9761	57.6000	56.9761	57.3000	57.2761
57.0000	57.2761	56.7000	57.5761	56.4000	57.5761
56.1000	57.8761	55.8000	57.8761	55.5000	58.1761
55.2000	58.1761	54.9000	58.4761	54.6000	58.4761
54.3000	58.7761	54.0000	58.7761	53.7000	59.0761
53.4000	59.0761	53.1000	59.3761	52.8000	59.3761
52.5000	59.6761	52.2000	59.6761	51.9000	59.9761
51.6000	59.9761	51.3000	60.2761	51.0000	60.2761
50.7000	60.5761	50.4000	60.5761	50.1000	60.8761
49.8000	60.8761	49.5000	61.1761	49.2000	61.1761
48.9000	61.4761	48.6000	61.4761	48.3000	61.7761
48.0000	61.7761	47.7000	62.0761	47.4000	62.0761
47.1000	62.3761	46.8000	62.3761	46.5000	62.6761
46.2000	62.6761	45.9000	62.9761	45.6000	62.9761
45.3000	63.2761	45.0000	63.2761	44.7000	63.5761
44.4000	63.5761	44.1000	63.8761	43.8000	63.8761
43.5000	64.1761	43.2000	64.1761	42.9000	64.4761
42.6000	64.4761	42.3000	64.7761	42.0000	64.7761
41.7000	65.0761	41.4000	65.0761	41.1000	65.3761
40.8000	65.3761	40.5000	65.6761	40.2000	65.6761
39.9000	65.9761	39.6000	65.9761	39.3000	66.2761
39.0000	66.2761	38.7000	66.5761	38.4000	66.5761
38.1000	66.8761	37.8000	66.8761	37.5000	67.1761
37.2000	67.1761	36.9000	67.4761	36.6000	67.4761
36.3000	67.7761	36.0000	67.7761	35.7000	68.0761
35.4000	68.0761	35.1000	68.3761	34.8000	68.3761
34.5000	68.6761	34.2000	68.6761	33.9000	68.9761
33.6000	68.9761	33.3000	69.2761	33.0000	69.2761
32.7000	69.5761	32.4000	69.5761	32.1000	69.8761
31.8000	69.8761	31.5000	70.1761	31.2000	70.1761
30.9000	70.4761	30.6000	70.4761	30.3000	70.7761
30.0000	70.7761	29.7000	71.0761	29.4000	71.0761
29.1000	71.3761	28.8000	71.3761	28.5000	71.6761
28.2000	71.6761	27.9000	71.9761	27.6000	71.9761
27.3000	72.2761	27.0000	72.2761	26.7000	72.5761
26.4000	72.5761	26.1000	72.8761	25.8000	72.8761
25.5000	73.1761	25.2000	73.1761	24.9000	73.4761
24.6000	73.4761	24.3000	73.7761	24.0000	73.7761
23.7000	74.0761	23.4000	74.0761	23.1000	74.3761
22.8000	74.3761	22.5000	74.6761	22.2000	74.6761

Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Input (continued)

21.9000	74.9761	21.6000	74.9761	21.3000	75.2761
21.0000	75.2761	20.7000	75.5761	20.4000	75.5761
20.1000	75.8761	19.8000	75.8761	19.5000	76.1761
19.2000	76.1761	18.9000	76.4761	18.6000	76.4761
18.4500	76.3261	18.4500	45.1261	18.7500	44.8261
18.7500	44.2261	19.0500	43.9261	19.0500	43.3261
19.3500	43.0261	19.3500	42.7261	19.6500	42.4261
19.6500	41.8261	19.9500	41.5261	19.9500	40.9261
20.2500	40.6261	20.2500	40.0261	20.5500	39.7261
20.5500	39.4261	20.8500	39.1261	20.8500	38.5261
21.1500	38.2261	21.1500	37.6261	21.4500	37.3261
21.4500	36.7261	21.7500	36.4261	21.7500	35.8261
22.0500	35.5261	22.0500	35.2261	22.3500	34.9261
22.3500	34.3261	22.6500	34.0261	22.6500	33.4261
22.9500	33.1261	22.9500	32.5261	23.2500	32.2261
23.2500	31.9261	23.5500	31.6261	23.5500	31.0261
23.8500	30.7261	23.8500	30.1261	24.1500	29.8261
24.1500	29.2261	24.4500	28.9261	24.4500	28.6261
24.7500	28.3261	24.7500	27.7261	25.0500	27.4261
25.0500	26.8261	25.3500	26.5261	25.3500	25.9261
25.6500	25.6261	25.8500	25.0261	25.9500	24.7261
25.9500	24.4261	26.4000	23.9761	26.7000	23.9761
27.0000	23.6761	30.0000	23.6761	30.3000	23.3761
33.3000	23.3761	33.6000	23.0761	36.6000	23.0761
36.9000	22.7761	39.9000	22.7761	40.2000	22.4761
43.2000	22.4761	43.5000	22.1761	46.5000	22.1761
46.8000	21.8761	49.8000	21.8761	50.1000	21.5761
53.1000	21.5761	53.4000	21.2761	56.4000	21.2761
56.7000	20.9761	60.0000	20.9761	60.3000	20.6761
63.3000	20.6761	63.6000	20.3761	66.3000	20.3761
66.4500	20.2261	66.4500	19.9261	66.7500	19.6261
66.7500	19.3261	68.7000	17.3761	69.0000	17.3761
69.3000	17.0761	69.6000	17.0761	69.9000	16.7761
70.2000	16.7761	70.5000	16.4761	70.8000	16.4761
71.1000	16.1761	71.4000	16.1761	71.7000	15.8761
72.0000	15.8761	72.3000	15.5761	72.6000	15.5761
72.9000	15.2761	73.2000	15.2761	73.5000	14.9761
73.8000	14.9761	74.1000	14.6761	74.4000	14.6761
74.7000	14.3761	75.3000	14.3761	75.6000	14.0761
78.0000	14.0761	78.3000	14.3761	78.9000	14.3761
79.2000	14.6761	79.8000	14.6761	80.4000	15.2761
80.7000	15.2761	81.0000	15.5761	81.3000	15.5761
82.8000	17.0761	83.1000	17.0761	83.5500	17.5261
83.5500	17.8261	84.7500	19.0261	84.7500	19.3261
85.6500	20.2261	85.6500	20.5261	85.9500	20.8261
85.9500	21.1261	86.2500	21.4261	86.2500	21.7261
86.5500	22.0261	86.5500	22.3261	86.8500	22.6261
86.8500	22.9261	87.1500	23.2261	87.1500	23.5261
87.4500	23.8261	87.4500	24.4261	87.7500	24.7261
87.7500	25.6261	88.0500	25.9261	88.0500	26.8261
88.3500	27.1261	88.3500	29.5261	88.6500	29.6761
88.8000	29.6761	89.1000	29.9761	89.4000	29.9761
89.7000	30.2761	90.0000	30.2761	90.3000	30.5761
90.6000	30.5761	90.9000	30.8761	91.2000	30.8761
91.5000	31.1761	91.8000	31.1761	92.1000	31.4761
92.4000	31.4761	92.7000	31.7761	93.0000	31.7761
300					
93.1500	31.9261	93.3000	32.0761	93.6000	32.0761
93.9000	32.3761	94.2000	32.3761	94.5000	32.6761
94.8000	32.6761	95.1000	32.9761	95.4000	32.9761
95.7000	33.2761	96.0000	33.2761	96.3000	33.5761
96.6000	33.5761	96.9000	33.8761	97.2000	33.8761
97.5000	34.1761	97.8000	34.1761	98.1000	34.4761

Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Input (continued)

98.4000	34.4761	98.7000	34.7761	99.0000	34.7761
99.3000	35.0761	99.6000	35.0761	99.9000	35.3761
100.2000	35.3761	100.5000	35.6761	100.8000	35.6761
101.1000	35.9761	101.4000	35.9761	101.7000	36.2761
102.0000	36.2761	102.3000	36.5761	102.6000	36.5761
102.9000	36.8761	103.2000	36.8761	103.5000	37.1761
103.8000	37.1761	104.1000	37.4761	104.4000	37.4761
104.7000	37.7761	105.0000	37.7761	105.3000	38.0761
105.6000	38.0761	105.9000	38.3761	106.2000	38.3761
106.5000	38.6761	106.8000	38.6761	107.1000	38.9761
107.4000	38.9761	107.7000	39.2761	108.0000	39.2761
108.3000	39.5761	108.6000	39.5761	108.9000	39.8761
109.2000	39.8761	109.5000	40.1761	109.8000	40.1761
110.1000	40.4761	110.4000	40.4761	110.7000	40.7761
111.0000	40.7761	111.3000	41.0761	111.6000	41.0761
111.9000	41.3761	112.2000	41.3761	112.5000	41.6761
112.8000	41.6761	113.1000	41.9761	113.4000	41.9761
113.7000	42.2761	114.0000	42.2761	114.3000	42.5761
114.6000	42.5761	114.9000	42.8761	115.2000	42.8761
115.5000	43.1761	115.8000	43.1761	116.1000	43.4761
116.4000	43.4761	116.7000	43.7761	117.0000	43.7761
117.3000	44.0761	117.6000	44.0761	117.9000	44.3761
118.2000	44.3761	118.5000	44.6761	118.8000	44.6761
119.1000	44.9761	119.4000	44.9761	119.7000	45.2761
120.0000	45.2761	120.3000	45.5761	120.6000	45.5761
120.9000	45.8761	121.2000	45.8761	121.5000	46.1761
121.8000	46.1761	122.1000	46.4761	122.4000	46.4761
122.7000	46.7761	123.0000	46.7761	123.3000	47.0761
123.6000	47.0761	123.9000	47.3761	124.2000	47.3761
124.5000	47.6761	124.8000	47.6761	125.1000	47.9761
125.4000	47.9761	125.7000	48.2761	126.0000	48.2761
126.3000	48.5761	126.6000	48.5761	126.9000	48.8761
127.2000	48.8761	127.5000	49.1761	127.8000	49.1761
128.1000	49.4761	128.4000	49.4761	128.7000	49.7761
129.0000	49.7761	129.3000	50.0761	129.6000	50.0761
129.9000	50.3761	130.2000	50.3761	130.5000	50.6761
130.8000	50.6761	131.1000	50.9761	131.4000	50.9761
131.7000	51.2761	132.0000	51.2761	132.3000	51.5761
132.6000	51.5761	132.9000	51.8761	133.2000	51.8761
133.5000	52.1761	133.8000	52.1761	134.1000	52.4761
134.4000	52.4761	134.7000	52.7761	135.0000	52.7761
135.3000	53.0761	135.6000	53.0761	135.9000	53.3761
136.2000	53.3761	136.5000	53.6761	136.8000	53.6761
137.1000	53.9761	137.4000	53.9761	137.7000	54.2761
138.0000	54.2761	138.3000	54.5761	138.6000	54.5761
138.9000	54.8761	139.2000	54.8761	139.5000	55.1761
139.8000	55.1761	140.1000	55.4761	140.4000	55.4761
140.7000	55.7761	141.0000	55.7761	141.3000	56.0761
141.6000	56.0761	141.9000	56.3761	142.2000	56.3761
142.5000	56.6761	142.8000	56.6761	143.1000	56.9761
143.4000	56.9761	143.7000	57.2761	144.0000	57.2761
144.3000	57.5761	144.6000	57.5761	144.9000	57.8761
145.2000	57.8761	145.5000	58.1761	145.8000	58.1761
146.1000	58.4761	146.4000	58.4761	146.7000	58.7761
147.0000	58.7761	147.3000	59.0761	147.6000	59.0761
147.9000	59.3761	148.2000	59.3761	148.5000	59.6761
148.8000	59.6761	149.1000	59.9761	149.4000	59.9761
149.7000	60.2761	150.0000	60.2761	150.3000	60.5761
150.6000	60.5761	150.9000	60.8761	151.2000	60.8761
151.5000	61.1761	152.1000	61.1761	153.3000	59.9761
153.6000	59.9761	153.9000	59.6761	154.2000	59.6761
154.5000	59.3761	154.8000	59.3761	155.1000	59.0761
155.4000	59.0761	155.7000	58.7761	156.0000	58.7761

Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Input (continued)

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156.3000    58.4761    156.6000    58.4761    156.9000    58.1761
157.2000    58.1761    157.5000    57.8761    157.8000    57.8761
158.1000    57.5761    158.4000    57.5761    158.7000    57.2761
159.0000    57.2761    159.3000    56.9761    159.6000    56.9761
159.9000    56.6761    160.2000    56.6761    161.1000    56.3761
162.0000    56.3761    162.3000    56.6761    163.5000    56.6761
163.8000    56.9761    164.1000    56.9761    164.4000    57.2761
164.7000    57.2761    165.0000    57.5761    165.3000    57.5761
165.6000    57.8761    165.9000    57.8761    166.5000    58.4761
166.8000    58.4761    169.0500    60.7261    169.0500    61.0261
169.9500    61.9261    169.9500    62.2261    170.5500    62.8261
170.5500    63.1261    170.8500    63.4261    170.8500    63.7261
171.4500    64.3261    171.4500    64.6261    171.7500    64.9261
171.7500    65.5261    172.0500    65.8261    172.0500    66.1261
172.3500    66.4261    172.3500    67.0261    172.6500    67.3261
172.6500    68.2261    172.9500    68.5261    172.9500    69.7261
173.2500    70.0261    173.2500    71.8261    173.7000    72.2761
174.0000    72.2761    174.3000    72.5761    174.6000    72.5761
174.9000    72.8761    175.2000    72.8761    175.9500    73.6261
175.9500    73.9261    176.5500    74.5261    176.5500    74.8261
177.4500    75.7261    177.4500    76.0261    178.0500    76.6261
178.0500    76.9261    178.6500    77.5261    178.6500    77.8261
179.5500    78.7261    179.5500    79.0261    180.1500    79.6261
180.1500    79.9261    180.7500    80.5261    180.7500    80.8261
181.6500    81.7261    181.6500    82.0261    182.2500    82.6261
182.2500    82.9261    182.8500    83.5261    182.8500    83.8261
183.7500    84.7261    183.7500    85.0261    184.3500    85.6261
184.3500    85.9261    184.6500    86.2261    184.6500    93.1261
183.1500    94.6261    183.1500    94.9261    181.6500    96.4261
181.6500    96.7261    180.4500    97.9261    180.4500    98.2261
178.9500    99.7261    178.9500   100.0261    178.8000   100.1761
      8
178.6500   100.3261    177.4500   101.5261    177.4500   101.8261
176.2500   103.0261    176.2500   103.3261    175.5000   104.0761
175.3500   103.9261    175.3500    73.3261
    300
109.5000   122.0761    109.2000   122.0761    108.9000   121.7761
108.6000   121.7761    108.3000   121.4761    108.0000   121.4761
107.7000   121.1761    107.4000   121.1761    107.1000   120.8761
106.8000   120.8761    106.5000   120.5761    106.2000   120.5761
105.9000   120.2761    105.6000   120.2761    105.3000   119.9761
105.0000   119.9761    104.7000   119.6761    104.4000   119.6761
104.1000   119.3761    103.8000   119.3761    103.5000   119.0761
103.2000   119.0761    102.9000   118.7761    102.6000   118.7761
102.3000   118.4761    102.0000   118.4761    101.7000   118.1761
101.4000   118.1761    101.1000   117.8761    100.8000   117.8761
100.5000   117.5761    100.2000   117.5761     99.9000   117.2761
 99.6000   117.2761     99.3000   116.9761     99.0000   116.9761
 98.7000   116.6761     98.4000   116.6761     98.1000   116.3761
 97.8000   116.3761     97.5000   116.0761     97.2000   116.0761
 96.9000   115.7761     96.6000   115.7761     96.3000   115.4761
 96.0000   115.4761     95.7000   115.1761     95.4000   115.1761
 95.1000   114.8761     94.8000   114.8761     94.5000   114.5761
 94.2000   114.5761     93.9000   114.2761     93.6000   114.2761
 93.3000   113.9761     93.0000   113.9761     92.7000   113.6761
 92.4000   113.6761     92.1000   113.3761     91.8000   113.3761
 91.5000   113.0761     91.2000   113.0761     90.9000   112.7761
 90.6000   112.7761     90.3000   112.4761     90.0000   112.4761
 89.7000   112.1761     89.4000   112.1761     89.1000   111.8761
 88.8000   111.8761     88.5000   111.5761     88.2000   111.5761
 87.9000   111.2761     87.6000   111.2761     87.3000   110.9761
 87.0000   110.9761     86.7000   110.6761     86.4000   110.6761
 86.1000   110.3761     85.8000   110.3761     85.5000   110.0761
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Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Input (continued)

85.2000	110.0761	84.9000	109.7761	84.6000	109.7761
84.3000	109.4761	84.0000	109.4761	83.7000	109.1761
83.4000	109.1761	83.1000	108.8761	82.8000	108.5761
82.5000	108.5761	82.2000	108.5761	81.9000	108.2761
81.6000	108.2761	81.3000	107.9761	81.0000	107.9761
80.7000	107.6761	80.4000	107.6761	80.1000	107.3761
79.8000	107.3761	79.5000	107.0761	79.2000	107.0761
78.9000	106.7761	78.6000	106.7761	78.3000	106.4761
78.0000	106.4761	77.7000	106.1761	77.4000	106.1761
77.1000	105.8761	76.8000	105.8761	76.5000	105.5761
76.2000	105.5761	75.9000	105.2761	75.6000	105.2761
75.3000	104.9761	75.0000	104.9761	74.7000	104.6761
74.4000	104.6761	74.1000	104.3761	73.8000	104.3761
73.5000	104.0761	73.2000	104.0761	72.9000	103.7761
72.6000	103.7761	72.3000	103.4761	72.0000	103.4761
71.7000	103.1761	71.4000	103.1761	71.1000	102.8761
70.8000	102.8761	70.5000	102.5761	70.2000	102.5761
69.9000	102.2761	69.6000	102.2761	69.3000	101.9761
69.0000	101.9761	68.7000	101.6761	68.4000	101.6761
68.1000	101.3761	67.8000	101.3761	67.5000	101.0761
67.2000	101.0761	66.9000	100.7761	66.6000	100.7761
66.3000	100.4761	66.0000	100.4761	65.7000	100.1761
65.4000	100.1761	65.1000	99.8761	64.8000	99.8761
64.5000	99.5761	64.2000	99.5761	63.9000	99.2761
63.6000	99.2761	63.3000	98.9761	63.0000	98.9761
62.7000	98.6761	62.4000	98.6761	62.1000	98.3761
61.8000	98.3761	61.5000	98.0761	61.2000	98.0761
60.9000	97.7761	60.6000	97.7761	60.3000	97.4761
60.0000	97.4761	59.7000	97.1761	59.4000	97.1761
59.1000	96.8761	58.8000	96.8761	58.5000	96.5761
58.2000	96.5761	57.9000	96.2761	57.6000	96.2761
57.3000	95.9761	57.0000	95.9761	56.7000	95.6761
56.4000	95.6761	56.1000	95.3761	55.8000	95.3761
55.5000	95.0761	55.2000	95.0761	54.9000	94.7761
54.6000	94.7761	54.3000	94.4761	54.0000	94.4761
53.7000	94.1761	53.4000	94.1761	53.1000	93.8761
52.8000	93.8761	52.5000	93.5761	52.2000	93.5761
51.9000	93.2761	51.6000	93.2761	51.3000	92.9761
51.0000	92.9761	50.7000	92.6761	50.4000	92.6761
50.1000	92.3761	49.8000	92.3761	49.5000	92.0761
49.2000	92.0761	48.9000	91.7761	48.6000	91.7761
48.3000	91.4761	48.0000	91.4761	47.7000	91.1761
47.4000	91.1761	47.1000	90.8761	46.8000	90.8761
46.5000	90.5761	46.2000	90.5761	45.9000	90.2761
45.6000	90.2761	45.3000	89.9761	45.0000	89.9761
44.7000	89.6761	44.4000	89.6761	44.1000	89.3761
43.8000	89.3761	43.5000	89.0761	43.2000	89.0761
42.9000	88.7761	42.6000	88.7761	42.3000	88.4761
42.0000	88.4761	41.7000	88.1761	41.4000	88.1761
41.1000	87.8761	40.8000	87.8761	40.5000	87.5761
40.2000	87.5761	39.9000	87.2761	39.6000	87.2761
39.3000	86.9761	39.0000	86.9761	38.7000	86.6761
38.4000	86.6761	38.1000	86.3761	37.8000	86.3761
37.5000	86.0761	37.2000	86.0761	36.9000	85.7761
36.6000	85.7761	36.3000	85.4761	36.0000	85.4761
35.7000	85.1761	35.4000	85.1761	35.1000	84.8761
34.8000	84.8761	34.5000	84.5761	34.2000	84.5761
33.9000	84.2761	33.6000	84.2761	33.3000	83.9761
33.0000	83.9761	32.7000	83.6761	32.4000	83.6761
32.1000	83.3761	31.8000	83.3761	31.5000	83.0761
31.2000	83.0761	30.9000	82.7761	30.6000	82.7761
30.3000	82.4761	30.0000	82.4761	29.7000	82.1761
29.4000	82.1761	29.1000	81.8761	28.8000	81.8761

Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Input (continued)

```
28.5000   81.5761   28.2000   81.5761   27.9000   81.2761
27.6000   81.2761   27.3000   80.9761   27.0000   80.9761
26.7000   80.6761   26.4000   80.6761   26.1000   80.3761
25.8000   80.3761   25.5000   80.0761   25.2000   80.0761
24.9000   79.7761   24.6000   79.7761   24.3000   79.4761
24.0000   79.4761   23.7000   79.1761   23.4000   79.1761
23.1000   78.8761   22.8000   78.8761   22.5000   78.5761
22.2000   78.5761   21.9000   78.2761   21.6000   78.2761
21.3000   77.9761   21.0000   77.9761   20.7000   77.6761
20.4000   77.6761   20.1000   77.3761   19.8000   77.3761
    6
19.6500   77.2261   19.5000   77.0761   19.2000   77.0761
18.9000   76.7761   18.6000   76.7761   18.4500   76.6261
   63
173.2500  72.1261  173.2500  73.9261  172.9500  74.2261
172.9500  75.1261  172.6500  75.4261  172.6500  75.7261
172.3500  76.0261  172.3500  76.3261  172.0500  76.6261
172.0500  76.9261  170.7000  78.2761  170.4000  78.2761
170.1000  78.5761  169.5000  78.5761  169.2000  78.8761
166.5000  78.8761  166.2000  78.5761  165.6000  78.5761
165.3000  78.2761  165.0000  78.2761  164.7000  77.9761
164.4000  77.9761  164.1000  77.6761  163.8000  77.6761
162.9000  76.7761  162.6000  76.7761  160.3500  74.5261
160.3500  74.2261  159.4500  73.3261  159.4500  73.0261
159.1500  72.7261  159.1500  72.4261  158.5500  71.8261
158.5500  71.5261  158.2500  71.2261  158.2500  70.9261
157.9500  70.6261  157.9500  70.3261  157.6500  70.0261
157.6500  69.4261  157.3500  69.1261  157.3500  68.8261
157.0500  68.5261  157.0500  67.6261  156.7500  67.3261
156.7500  66.4261  156.4500  66.1261  156.4500  63.7261
156.0000  63.2761  155.7000  63.2761  155.4000  62.9761
155.1000  62.9761  154.8000  62.6761  154.5000  62.6761
154.2000  62.3761  153.9000  62.3761  153.6000  62.0761
153.3000  62.0761  153.0000  61.7761  152.7000  61.7761
152.4000  61.4761  152.1000  61.4761  151.9500  61.3261
   11
156.4500  63.4261  156.4500  61.0261  156.7500  60.7261
156.7500  60.1261  157.0500  59.8261  157.0500  59.5261
157.3500  59.2261  157.3500  58.9261  157.9500  58.3261
157.9500  58.0261  158.2500  57.7261
    2
159.6000  73.1761  159.7500  73.3261
    2
160.5000  74.3761  160.6500  74.5261
    2
158.8500  57.4261  158.7000  57.5761
   59
88.3500   29.8261   88.3500   31.6261   88.0500   31.9261
88.0500   32.8261   87.7500   33.1261   87.7500   33.4261
87.4500   33.7261   87.4500   34.0261   86.8500   34.6261
86.8500   34.9261   86.4000   35.3761   86.1000   35.3761
85.5000   35.9761   85.2000   35.9761   84.9000   36.2761
84.3000   36.2761   84.0000   36.5761   82.2000   36.5761
81.9000   36.2761   81.0000   36.2761   80.7000   35.9761
80.4000   35.9761   80.1000   35.6761   79.8000   35.6761
79.5000   35.3761   79.2000   35.3761   78.6000   34.7761
78.3000   34.7761   75.1500   31.6261   75.1500   31.3261
74.5500   30.7261   74.5500   30.4261   73.9500   29.8261
73.9500   29.5261   73.6500   29.2261   73.6500   28.9261
73.3500   28.6261   73.3500   28.3261   73.0500   28.0261
73.0500   27.7261   72.7500   27.4261   72.7500   27.1261
72.4500   26.8261   72.4500   26.2261   72.1500   25.9261
72.1500   25.0261   71.8500   24.7261   71.8500   23.8261
```

Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Input (continued)

```
71.5500   23.5261   71.5500   21.1261   71.4000   20.9761
71.1000   20.9761   70.8000   20.6761   70.5000   20.6761
70.2000   20.3761   69.9000   20.3761   69.6000   20.0761
66.9000   20.0761   66.6000   20.3761
    2
69.4500   20.2261   69.4500   51.1261
   11
71.5500   20.8261   71.5500   18.7261   71.6500   18.4261
71.8500   17.8261   72.1500   17.5261   72.1500   17.2261
72.4500   16.9261   72.4500   16.6261   72.7500   16.3261
72.7500   16.0261   73.6500   15.1261
    2
72.6000   26.6761   72.7500   26.8261
    2
81.0000   35.9761   81.1500   36.1261
    2
74.2500   14.8261   74.1000   14.9761
  100
26.5500   24.1261   26.7000   24.2761   27.0000   24.2761
27.6000   24.8761   27.9000   24.8761   28.2000   25.1761
28.5000   25.1761   29.1000   25.7761   29.4000   25.7761
30.0000   26.3761   30.3000   26.3761   30.9000   26.9761
31.2000   26.9761   31.5000   27.2761   31.8000   27.2761
32.4000   27.8761   32.7000   27.8761   33.3000   28.4761
33.6000   28.4761   34.2000   29.0761   34.5000   29.0761
34.8000   29.3761   35.1000   29.3761   35.7000   29.9761
36.0000   29.9761   36.6000   30.5761   36.9000   30.5761
37.2000   30.8761   37.5000   30.8761   38.1000   31.4761
38.4000   31.4761   39.0000   32.0761   39.3000   32.0761
39.9000   32.6761   40.2000   32.6761   40.5000   32.9761
40.8000   32.9761   41.4000   33.5761   41.7000   33.5761
42.3000   34.1761   42.6000   34.1761   42.9000   34.4761
43.2000   34.4761   43.8000   35.0761   44.1000   35.0761
44.7000   35.6761   45.0000   35.6761   45.6000   36.2761
45.9000   36.2761   46.2000   36.5761   46.5000   36.5761
47.1000   37.1761   47.4000   37.1761   48.0000   37.7761
48.3000   37.7761   48.9000   38.3761   49.2000   38.3761
49.5000   38.6761   49.8000   38.6761   50.4000   39.2761
50.7000   39.2761   51.3000   39.8761   51.6000   39.8761
51.9000   40.1761   52.2000   40.1761   52.8000   40.7761
53.1000   40.7761   53.7000   41.3761   54.0000   41.3761
54.6000   41.9761   54.9000   41.9761   55.2000   42.2761
55.5000   42.2761   56.1000   42.8761   56.4000   42.8761
57.0000   43.4761   57.3000   43.4761   57.6000   43.7761
57.9000   43.7761   58.5000   44.3761   58.8000   44.3761
59.4000   44.9761   59.7000   44.9761   60.3000   45.5761
60.6000   45.5761   60.9000   45.8761   61.2000   45.8761
61.8000   46.4761   62.1000   46.4761   62.7000   47.0761
63.0000   47.0761   63.6000   47.6761   63.9000   47.6761
64.2000   47.9761   64.5000   47.9761   65.1000   48.5761
65.4000   48.5761   66.0000   49.1761   66.3000   49.1761
66.6000   49.4761   66.9000   49.4761   67.5000   50.0761
67.8000   50.0761   68.4000   50.6761   68.7000   50.6761
69.1500   51.1261
    2
26.2500   24.4261   26.1000   24.5761
   51
25.9500   25.0261   25.9500   26.5261   25.6500   26.8261
25.8500   28.6261   25.3500   28.9261   25.3500   30.4261
25.0500   30.7261   25.0500   32.5261   24.7500   32.8261
24.7500   34.6261   24.4500   34.9261   24.4500   36.7261
24.1500   37.0261   24.1500   36.8261   23.8500   39.1261
23.8500   40.6261   23.5500   40.9261   23.5500   42.7261
```

Table XXIX. PICTUR Option Output on FORTRAN Unit 2 Using Sample Input (continued)

23.2500	43.0261	23.2500	44.8261	22.9500	45.1261
22.9500	46.9261	22.6500	47.2261	22.6500	48.7261
22.3500	49.8261	22.3500	50.8261	22.0500	51.1261
22.0500	52.9261	21.7500	53.2261	21.7500	55.0261
21.4500	55.3261	21.4500	57.1261	21.1500	57.4261
21.1500	58.9261	20.8500	59.2261	20.8500	61.0261
20.5500	61.3261	20.5500	63.1261	20.2500	63.4261
20.2500	65.2261	19.9500	65.5261	19.9500	67.0261
19.6500	67.3261	19.6500	69.1261	19.3500	69.4261
19.3500	71.2261	19.0500	71.5261	19.0500	73.3261
18.7500	73.6261	18.7500	75.4261	18.6000	75.5761
164					
116.5500	92.2261	116.8500	92.5261	116.8500	92.8261
117.1500	93.1261	117.1500	93.7261	117.4500	94.0261
117.4500	97.3261	117.1500	97.6261	117.1500	98.5261
116.8500	98.8261	116.8500	99.4261	116.5500	99.7261
116.5500	100.0261	116.2500	100.3261	116.2500	100.6261
115.6500	101.2261	115.6500	101.5261	112.8000	104.3761
112.5000	104.3761	112.2000	104.6761	111.9000	104.6761
111.3000	105.2761	111.0000	105.2761	110.7000	105.5761
110.1000	105.5761	109.8000	105.8761	109.5000	105.8761
109.2000	106.1761	108.3000	106.1761	108.0000	106.4761
107.1000	106.4761	106.8000	106.7761	104.7000	106.7761
104.4000	107.0761	101.4000	107.0761	101.1000	106.7761
99.0000	106.7761	98.7000	106.4761	97.5000	106.4761
97.2000	106.1761	96.0000	106.1761	95.7000	105.8761
95.1000	105.8761	94.8000	105.5761	94.2000	105.5761
93.9000	105.2761	93.3000	105.2761	93.0000	104.9761
92.7000	104.9761	92.4000	104.6761	91.8000	104.6761
91.5000	104.3761	91.2000	104.3761	90.9000	104.0761
90.6000	104.0761	90.3000	103.7761	90.0000	103.7761
89.7000	103.4761	89.4000	103.4761	89.1000	103.1761
88.8000	103.1761	88.2000	102.5761	87.9000	102.5761
87.6000	102.2761	87.3000	102.2761	86.7000	101.6761
86.4000	101.6761	85.5000	100.7761	85.2000	100.7761
84.0000	99.5761	83.7000	99.5761	80.8500	96.7261
80.8500	96.4261	79.9500	95.5261	79.9500	95.2261
79.0500	94.3261	79.0500	94.0261	78.7500	93.7261
78.7500	93.4261	78.1500	92.8261	78.1500	92.5261
77.8500	92.2261	77.8500	91.6261	77.5500	91.3261
77.5500	91.0261	77.2500	90.7261	77.2500	90.1261
76.9500	89.8261	76.9500	89.2261	76.6500	88.9261
76.6500	88.0261	76.3500	87.7261	76.3500	84.4261
76.6500	84.1261	76.6500	83.8261	77.2500	83.2261
77.2500	82.9261	77.7000	82.4761	78.0000	82.4761
78.6000	81.8761	78.9000	81.8761	79.2000	81.5761
79.5000	81.5761	79.8000	81.2761	80.1000	81.2761
80.4000	80.9761	81.0000	80.9761	81.3000	80.6761
82.2000	80.6761	82.5000	80.3761	84.3000	80.3761
84.6000	80.0761	90.0000	80.0761	90.3000	80.3761
92.7000	80.3761	93.6000	80.6761	94.5000	80.6761
94.8000	80.9761	96.0000	80.9761	96.3000	81.2761
97.2000	81.2761	97.5000	81.5761	98.4000	81.5761
98.7000	81.8761	99.6000	81.8761	99.9000	82.1761
100.5000	82.1761	100.8000	82.4761	101.4000	82.4761
101.7000	82.7761	102.3000	82.7761	102.6000	83.0761
103.2000	83.0761	103.5000	83.3761	103.8000	83.3761
104.1000	83.6761	104.7000	83.6761	105.0000	83.9761
105.3000	83.9761	105.6000	84.2761	105.9000	84.2761
106.2000	84.5761	106.5000	84.5761	106.8000	84.8761
107.1000	84.8761	107.4000	85.1761	107.7000	85.1761
108.0000	85.4761	108.3000	85.4761	108.6000	85.7761
108.9000	85.7761	109.2000	86.0761	109.5000	86.0761
109.8000	86.3761	110.1000	86.3761	110.7000	86.9761
111.0000	86.9761	111.6000	87.5761	111.9000	87.5761
112.8000	85.4761	113.1000	88.4761	116.2500	91.6261
116.2500	91.9261	116.4000	92.0761		
0					

1-60	61-70	71-80
ITITLE		DAY

FORMAT 6A10, 10X, A10)

ITITLE - Title of COM-GEOM description.

DAY - Date this view was written.

Figure 52. Title Line of PICTUR Output on FORTRAN Unit 2

1-12	13-24	25-36	37-48	49-60	61-80
A	E	HORZ	VERT	SMESH	

FORMAT (5F12.4)

A - Azimuth angle in degrees.

E - Elevation angle in degrees.

HORZ - Horizontal length of the grid.

VERT - Vertical length of the grid.

SMESH - Grid cell size

Figure 53. View Line of PICTUR Output on FORTRAN Unit 2

1-10	11-80
'1'	

FORMAT (I10)

1-12	13-24	25-36	37-48	49-80
H	V	XPLOTC	YPLOTC	

FORMAT (6F12.4)

H - One-half the horizontal length of the grid.

V - One-half the vertical length of the grid.

XPLOTC - Horizontal distance in the view plane the origin of the COM-GEOM is from the lower left corner of grid.

YPLOTC - Vertical distance in the view plane the origin of the COM-GEOM is from the lower left corner of grid.

Figure 54. Center of Target Lines of PICTUR Output on FORTRAN Unit 2

1-10	11-80
LINC	

FORMAT (I10)

LINC - Number of points that follow.
If zero, end of view.
If less than zero, restart information follows.

Figure 55. Number of Points Line of PICTUR Output on FORTRAN Unit 2

1-12	13-24	25-36	37-48	49-60	61-72	73-80
X(L)	Y(L)	X(L)	Y(L)	X(L)	Y(L)	

FORMAT (6F12.4)

X(L) - Horizontal distance of plotting point from the lower left corner of grid.

Y(L) - Vertical distance of plotting point from the lower left corner of grid.

Figure 56. Plotter Point Lines of PICTUR Output on FORTRAN Unit 2

1-10	11-15	16-20	21-80
'VIEW'	NOP(3)	NOP(4)	

FORMAT (4A5)

NOP(I) - Specify code to denote which views are desired. Allowable code words are:

"FRONT" - Azimuth 0°, Elevation 0°

"SIDE" - Azimuth 270°, Elevation 0°

"TOP" - Azimuth 270°, Elevation 90°

"ALL" - All three views

Figure 57. VIEW Card for PLTRPP Option

1-10	11-15	16-80
'NUMBER'	NCH	

FORMAT (2A5,I5)

NCH - Specify the number of regions to be depicted per plot (Range = 1 - 35, Default = 20)

Figure 58. NUMBER Card for PLTRPP Option

1-10	11-80
'END POINT'	

FORMAT (A5)

Only the end points of the region RPPs are plotted.

Figure 59. END POINT Card for PLTRPP Option

1-10	11-15	16-20		71-75	76-80
'REGION'	NOP(3)	NOP(4)	•••	NOP(15)	NOP(16)
'ITEM'					

"REGION" - List regions whose RPP equivalents are to be plotted.

"ITEM" - List item codes whose region RPP equivalents are to be plotted.

NOP(I) - Specify which regions or item codes whose region RPP equivalents are to be plotted. Integer numbers or code words are allowed. Allowable code words are:

"ALL" - Plot region RPP equivalents of all regions.

"THRU" - Through, "REGION 100 THRU 150" means plot region RPP equivalents of regions 100 through 150.

(Blank card signals end of the list of regions or item codes)

Figure 60. List Card for PLTRPP Option

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
P	L	T	R	P	P																								
R	E	G	I	O	N					A	L	L																	
V	I	E	W							S	I	D	E																
N	U	M	B	E	R									5															
E	N	D		P	O	I	N	T																					
I	T	E	M							1	0	0	0		T	H	R	U			9	9	9	9					

Figure 61. Sample Input for PLTRPP Option

Table XXX. Sample Output for PLTRPP Option
(Compressed for Display)

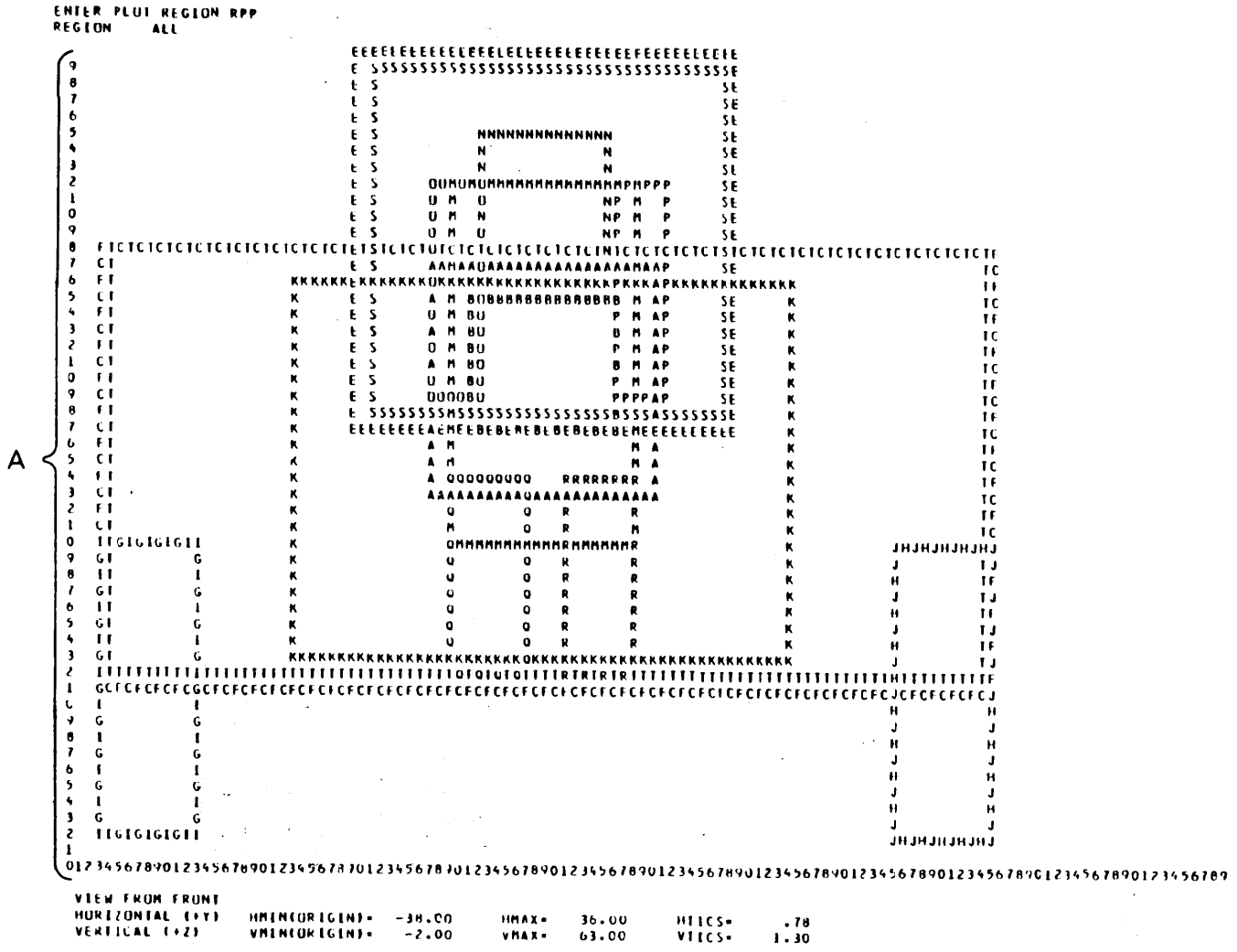
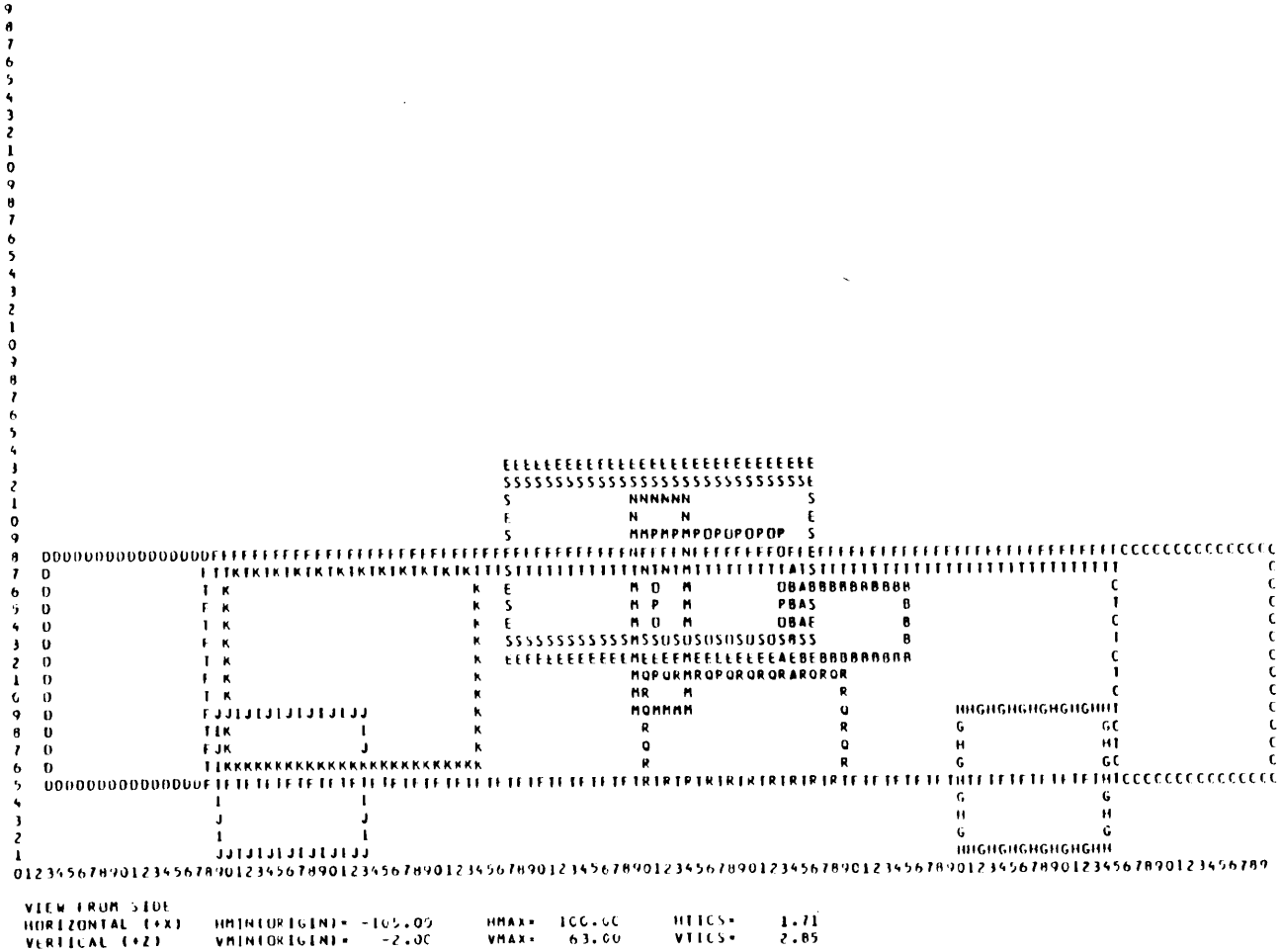


Table XXX. Sample Output for PLTRPP Option (continued)
(Compressed for Display)

REGION	SYMBOL	ITEM CODE	SPACE CODE	DESCRIPTION		
1	A	40	0	STEERING WHEEL	1-2	TOR
2	B	1041	0	STEERING SHAFT	2	ARB4
3	C	100	0	BODY-FRONT	3	ARB5
4	D	100	0	BODY-REAR	4	ARB8
5	E	101	0	BUBBLE	5-6-19	ELL
6	F	100	0	BODY-CENTER	6-20-19-7-8-9-10	RPP
7	G	651	0	WHEEL RIGHT FRONT	7	RCC
8	H	652	0	WHEEL LEFT FRONT	8	RCC
9	I	653	0	WHEEL RIGHT REAR	9	RCC
10	J	654	0	WHEEL LEFT REAR	10	RCC
11	K	2701	0	ENGINE	11-12	ARS
12	L	111	0	DUMMY REGION	0	RAW
13	M	3031	0	MAN-TORSO	13-15-16-17-18	REC
14	N	3031	0	MAN-HEAD	14-13	SPH
15	O	3031	0	MAN-ARM	15	TEC
16	P	3031	0	MAN-ARM	16	TEC
17	Q	3031	0	MAN-LEG	17	TRC
18	R	3031	0	MAN-LEG	18	TRC
19	S	0	2	INSIDE AIR (BUBBLE)		ELL1
20	T	0	2	INSIDE AIR (BODY)	20	BOX

Table XXX. Sample Output for PLTRPP Option (continued)
(Compressed for Display)



VIEW FROM SIDE
HORIZONTAL (+X) HMIN(ORIGIN)= -105.00 HMAX= 100.00 HTICS= 1.71
VERTICAL (+Z) VMIN(ORIGIN)= -2.00 VMAX= 63.00 VTICS= 2.85

Table XXX. Sample Output for PLTRPP Option (continued)
Compressed for Display)

REGION	SYMBOL	ITEM CODE	SPACE CODE	DESCRIPTION		
1	A	40	0	STEERING WHEEL	1-2	TOR
2	B	1041	0	STEERING SHAFT	2	ARB4
3	C	100	0	BODY-FRONT	3	ARH5
4	D	100	0	BODY-REAR	4	ARH8
5	E	101	0	BUBBLE	5-6-19	ELL
6	F	100	0	BODY-CENTER	6-20-19-7-8-9-10	RPP
7	G	651	0	WHEEL RIGHT FRONT	7	RCC
8	H	652	0	WHEEL LEFT FRONT	8	RCC
9	I	653	0	WHEEL RIGHT REAR	9	RCC
10	J	654	0	WHEEL LEFT REAR	10	RCC
11	K	2701	0	ENGINE	11-12	AFS
12	L	111	0	DUMMY REGION	0	RAW
13	M	3031	0	MAN-TORSO	13-15-16-17-18	REC
14	N	3031	0	MAN-HEAD	14-13	SPH
15	O	3031	0	MAN-ARM	15	TEC
16	P	3031	0	MAN-ARM	16	TEC
17	Q	3031	0	MAN-LEG	17	TRC
18	R	3031	0	MAN-LEG	18	TRC
19	S	0	2	INSIDE AIR (BUBBLE)		ELL1
20	T	0	2	INSIDE AIR (BODY)	20	BOX

Table XXX. Sample Output for PLTRPP Option (continued)
(Compressed for Display)

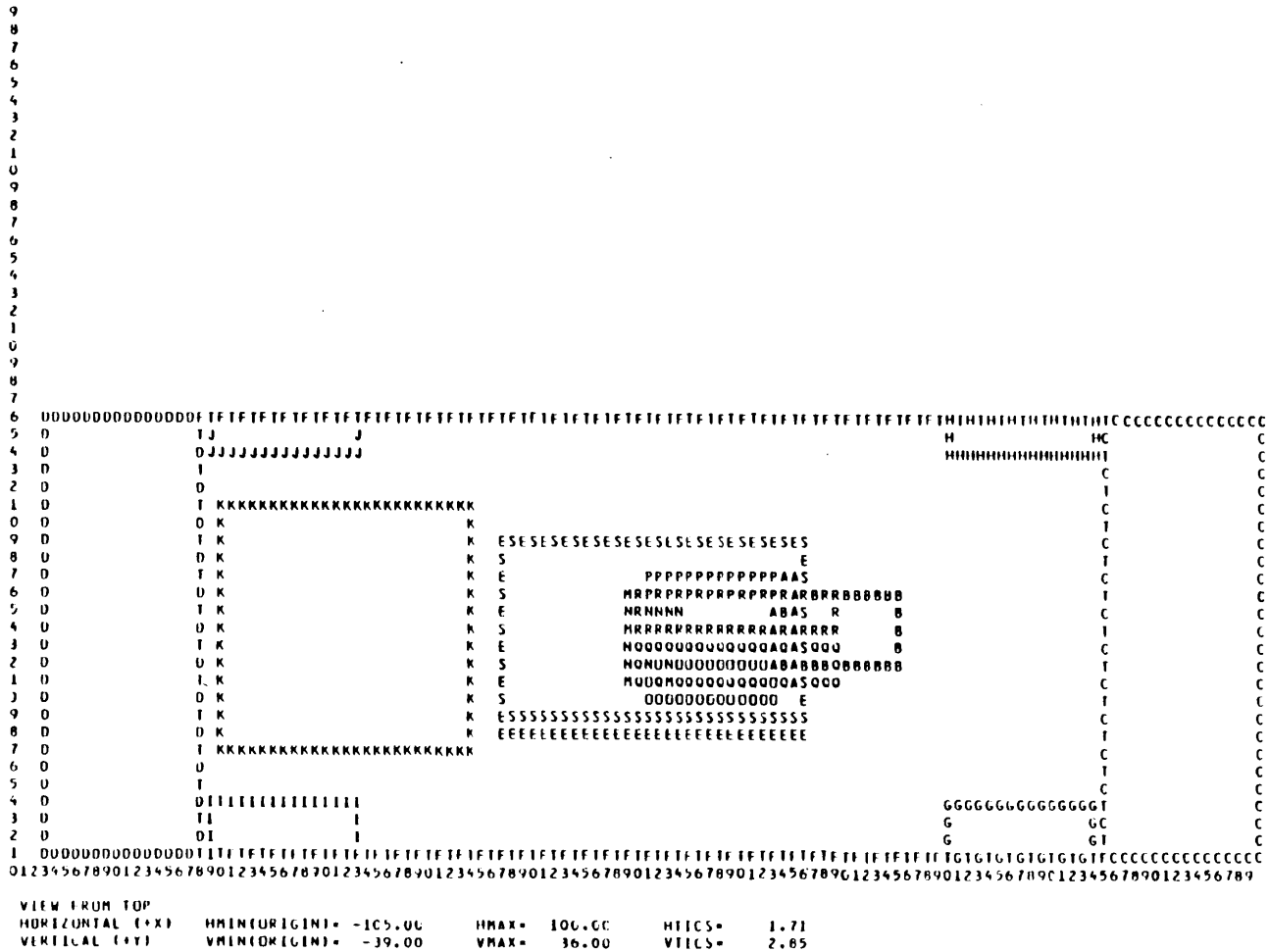
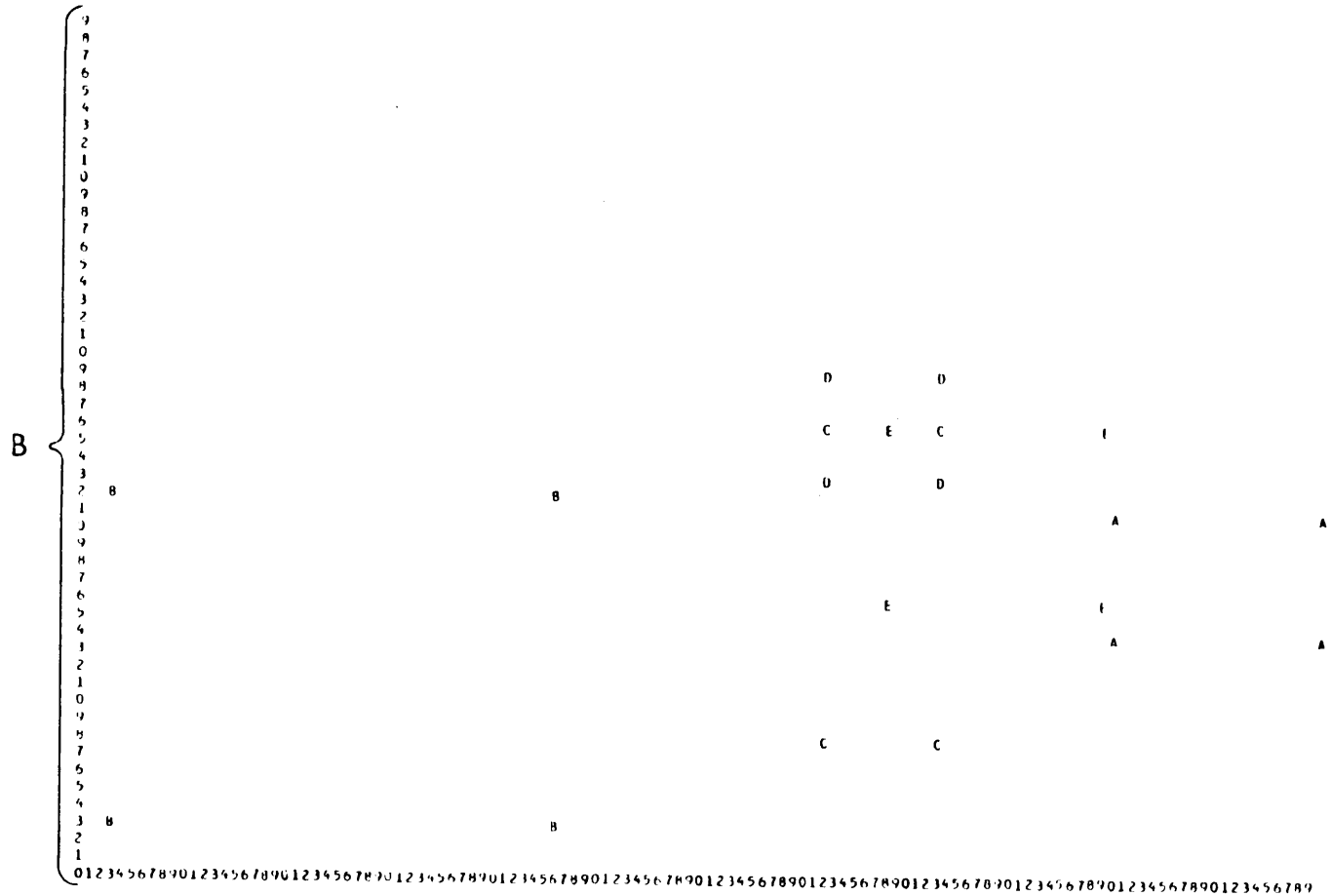


Table XXX. Sample Output for PLTRPP Option (continued)
(Compressed for Display)

REGION	SYMBOL	ITEM CODE	SPACE CODE	DESCRIPTION		
1	A	40	0	STEERING WHEEL	1-2	TOR
2	B	1041	0	STEERING SHAFT	2	ARB4
3	C	100	0	BODY-FRONT	3	ARB5
4	D	100	0	BODY-REAR	4	ARB8
5	E	101	0	BUBBLE	5-6-19	ELL
6	F	100	0	BODY-CENTER	6-20-19-7-8-9-10	RPP
7	G	651	0	WHEEL RIGHT FRONT	7	RCC
8	H	652	0	WHEEL LEFT FRONT	8	RCC
9	I	653	0	WHEEL RIGHT REAR	9	RCC
10	J	654	0	WHEEL LEFT REAR	10	RCC
11	K	2701	0	ENGINE	11-12	ARS
12	L	111	0	DUMMY REGION	0	RAW
13	M	3031	0	MAN-TORSO	13-15-16-17-18	REC
14	N	3031	0	MAN-HEAD	14-13	SPH
15	O	3031	0	MAN-ARM	15	TEC
16	P	3031	0	MAN-ARM	16	TEC
17	Q	3031	0	MAN-LEG	17	TRC
18	R	3031	0	MAN-LEG	18	TRC
19	S	0	2	INSIDE AIR (BUBBLE)		ELL1
20	T	0	2	INSIDE AIR (BODY)	20	BOX

VIEW SIDE
NUMBER 5
END POINT
ITEM 1000 THRU 9999

Table XXX. Sample Output for PLTRPP Option (continued)
(Compressed for Display)



VIEW FROM SIDE
HORIZONTAL (+X) HMIN(ORIGIN)= -73.00 HMAX= 40.00 HTICS= .94
VERTICAL (+Z) VMIN(ORIGIN)= 11.00 VMAX= 57.00 VTICS= 1.57

REGION	SYMBOL	ITEM CODE	SPACE CODE	DESCRIPTION		
2	A	1041	0	STEERING SHAFT	2	ARBS
11	B	2701	0	ENGINE	11-12	ARS
13	C	3031	0	MAN-TORSO	13-15-16-17-18	REC
14	D	3031	0	MAN-HEAD	14-13	SPH
15	E	3031	0	MAN-ARM	15	TEC

Table XXX. Sample Output for PLTRPP OPtion (continued)
(Compressed for Display)


```
VIEW FROM SIDE
HORIZONTAL (+X)    HMIN(ORIGIN)=  -73.00      HMAX=   40.00      HTICS=     .94
VERTICAL (+Z)      VMIN(ORIGIN)=   11.00      VMAX=   57.60      VTICS=    1.57

          REGION      SYMBOL      ITEM CODE      SPACE CODE                    DESCRIPTION
            16           A           3031              0          MAN-ARM          16              IFC
            17           B           3031              0          MAN-LEG          17              IRC
            18           C           3031              0          MAN-LEG          18              IRC

LEAVE PLOT REGION RPP
```

denote a region RPP. For example, letters "A" and "O" alternate along the left side of the rectangle denoting the RPP of Region 1. The approximate values of the region RPP can be calculated by using the "HMIN", "VMIN", "HTICS" and "VTICS". In Table XXX, for example, the YMIN(HMIN) of the RPP for Region 1 is approximately -9.14 (HMIN plus the number of columns from HMIN times HTICS or -38 + 37 x .78). The sections of Table XXX labeled B and C are for one set of region RPPs; however, the number of region RPPs to each plot is limited to five so two plots were required. Only the endpoints of the region RPPs were plotted in plots B anc C.

G. RIP Option

The RIP option produces data used for vulnerability analysis which simulates the geometry of a spall producing penetrator. Figure 62 depicts the simulation scheme used by the RIP option. The inherent scheme in the RIP option allows generation of a primary ray by either of two methods: one similar to the GRID option and the other similar to the TESTG option. This primary ray is traced through the COM-GEOM description and locates the first intersection of the ray with armor (Item Code 100-199) having interior air (Space Code 2 or 5) or a fuel tank (Item Code 230-239) following it. A burst point (B) is computed at the intersection of the inner surface of the selected armor with the primary ray. A selected number of spall rays are randomly directed toward the RPP of each vulnerable region (Item Code greater than 999) from the burst point. Those vulnerable regions are ignored that lie outside a specific cone (half angle = 60 degrees) whose height vector lies on the primary ray. Next RIP computes the intersections of the shielding regions between the burst point and the vulnerable region along a spall ray. If the number of shielding regions located between the burst point and the vulnerable region along a spall ray exceeds a maximum allowed (MRBVC), computing terminates and no output is given for that spall ray. Figures 63 through 67 describe the input for the RIP option.

Tables XXXI through XXXIII are generated when the COM-GEOM description listed in Table I and the input for the RIP option in Figure 68 is used. The section labeled A in Table XXXI describes the Enclosing RPP of the Target. The section labeled B describes the grid for this view. The section labeled C contains the output for the primary ray. Figures 71 and 72 describe the information in these lines. Figure 73 describes the burst point data contained in the line labeled D. The section labeled E contains the summary information for each vulnerable region associated with the burst point defined in the line labeled D.

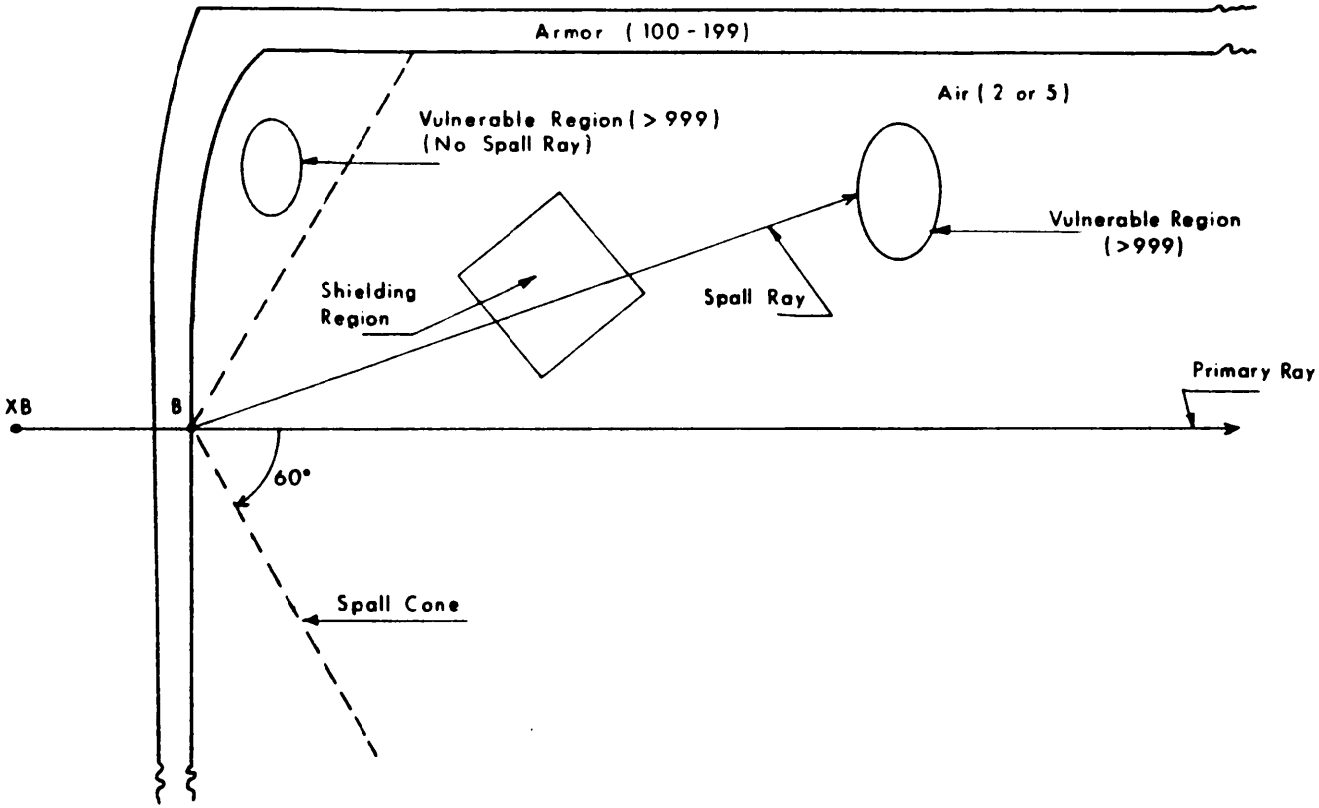


Figure 62. The Spall Simulation Scheme Used by the RIP Option

1-10	11-20	21-30	31-40	41-50	51-60	61-80
NOAA	NRVC	NOPRNT	IRPP	NOGRID	IONLY	

FORMAT (8I10)

NOAA - Specify the number of aspect angles or primary rays.

NRVC - Specify the number of rays to be directed toward each region defined as vulnerable (Default = 10).

NOPRINT- If not zero, do not write burst point summary data on printer.

IRPP - If not zero, read a Target Enclosing RPP card.

NOGRID - If zero, a grid is used to generate primary rays. If not zero, each primary ray is specified.

IONLY - If not zero, do not compute normal distances through regions.

Figure 63. Control Card for RIP Option

1-10	11-20	21-30	31-40	41-50	51-60	61-80
XMIN	XMAX	YMIN	YMAX	ZMIN	ZMAX	

FORMAT (6F10.0)

The minimum (min) and maximum (max) values of the x, y, and z coordinates which bound the rectangular parallelepiped that encloses the COM-GEOM description. (Default is the Englosing RPP located at LENRPP in the ASTER array.)

Figure 64. Target Enclosing RPP Card for RIP Option (Optional, Read Only if IRPP Not Zero on Control Card)

1-5	6-8	9-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
MAXT	TIMEUN		HCENTR	VCENTR	IHORZ	IVERT	ISEED	NFILE	

FORMAT (I5,A3,2X,2F10.0,FI10)

MAXT - Specify the maximum time that is indicated for the computer run.

TIMEUN - Specify a code to denote the units used for the maximum time. Allowable codes are: "HR" = HOURS, "MIN" = MINUTES, "SEC" = SECONDS (Default = "MIN")

The remainder of the variables are specified only if this run is a continuation of a previous run. They are obtained from the printout of the previous run.

HCENTR - Specify the horziontal location of the center of the grid cell.

VCENTR - Specify the vertical location of the center of the grid cell.

IHORZ - Specify the vertical cell matrix position.

ISEED - Specify seed for random number generator.

NFILE - Specify the number of files to skip on FORTRAN Unit 2.

Figure 65. Restart Card for RIP Option

1-10	11-20	21-30	31-40	41-50	51-60	61-80
A	E	CELSIZ	GROUND	MAXERR	ICENTR	

FORMAT (4E10.3,3I10)

A - Specify azimuth angle in degrees.

E - Specify elevation angle in degrees.

CELSIZ - Specify grid cell size (Default = 4.0)

GROUND - Specify z-coordinate for the ground of the COM-GEOM description. A primary ray will not be traced from any location which is less than GROUND. Specifying a value for GROUND should only be considered when a negative elevation angle (E) is specified. (Default = ZMIN of the Target Enclosing RPP).

MAXERR - Specify the maximum number of overlap errors that will be tolerated for each primary ray (Default = 25).

ICENTR - If equal zero, rays are traced through a random point in the grid cell. If not zero, rays are traced through the center of the grid cell.

Figure 66. View Card for RIP Option (Optional, Read Only If NOGRID on Control Card is Zero)

1-5	6-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
MAXERR	IRAY	XB(1)	XB(2)	XB(3)				
					XE(1)	XE(2)	XE(3)	
					WB(1)	WB(2)	WB(3)	
					A	E		

Iray = 1
Iray = 2
Iray = 3

FORMAT (2I5,6F10.4)

MAXERR - Specify the maximum number of overlap errors that will be tolerated for each primary ray (Default = 25).

IRAY - Specify a code number which indicates the method of describing the primary ray. If IRAY equals 1, track a ray between two points. If IRAY equals 2, track a ray from a starting point with a direction specified by a unit vector. If IRAY equals 3, track a ray from a starting point with a direction specified by azimuth and elevation angles.

XB(I) - Specify the starting point of the ray.

XE(I) - Specify the end point of the ray.

WB(I) - Specify a unit vector giving the ray direction.

A - Specify the azimuth angle in degrees.

E - Specify the elevation angle in degrees.

Figure 67. Primary Ray Card for RIP Option (Optional, Read Only if NOGRID on Control Card is Not Zero)

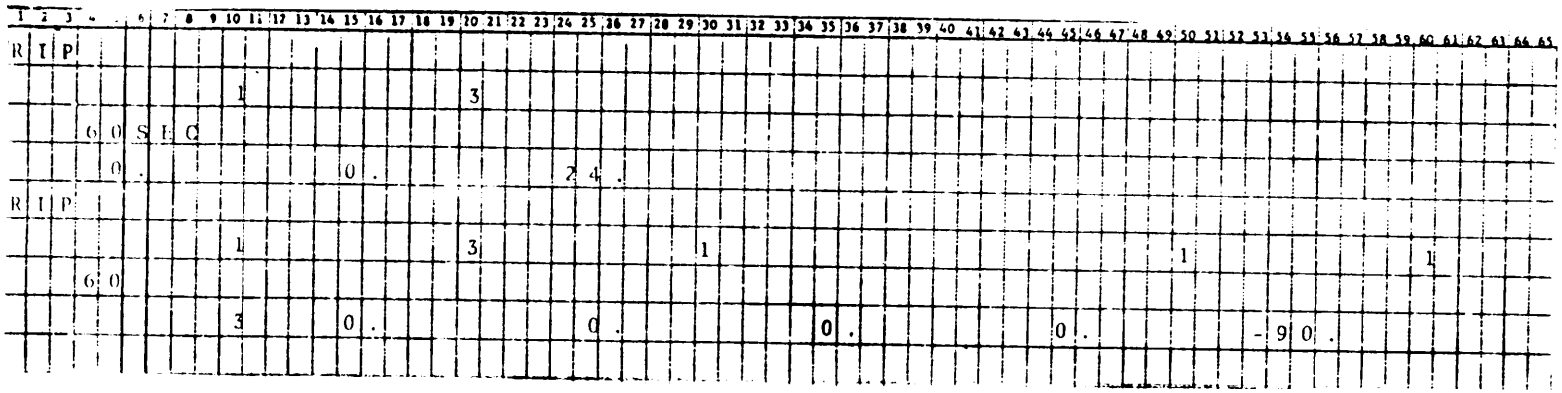


Figure 68. Sample Input for RIP Option

Table XXXI. RIP Option Sample Printout when Main Rays are Computed by a Grid (Compressed for Display)

```
ENTER RIP

NUMBER OF ASPECT ANGLES (MAIN RAYS) FOR RIP     1

NUMBER OF RAYS PER VULNERABLE COMPONENT     3

MAXIMUM TIME FOR RIP     60 SEC

AZIMUTH                  0.000
ELEVATION                0.000

                          X          Y          Z
A  TARGET MINIMUM      -100.000   -36.000      .000
   TARGET MAXIMUM       100.000    36.000    63.000
   TARGET CENTER          0.000     0.000    31.500
   TARGET DIMENSIONS    200.000    72.000    63.000

B  GRID PLANE
   BACK OFF DISTANCE    120.000
   GROUND                 0.000
   CELL SIZE             24.000
   HORIZONTAL LENGTH     72.000
   VERTICAL LENGTH       63.000
   CENTER                 0.000    31.500
   HORIZONTAL RANGE     -48.000    48.000
   VERTICAL RANGE         0.000    72.000

   NUMBER HORZ CELLS          5
   NUMBER VERT CELLS          4
   NUMBER OF CELLS           20

FIRST SEED FOR RANDOM NUMBER GENERATOR           0

OPTION SET TO COMPUTE RANDOM POINT IN CELL
HCENTR   48.0000 VCENTR   72.0000 IHORZ   1 IVERT   1 ISEED 52613407 COUNT   -1. CELTIM     .03 CELAVG     0.00 CUMTIM     5.57
HCENTR   24.0000 VCENTR   72.0000 IHORZ   2 IVERT   1 ISEED 21149111 COUNT   -1. CELTIM    0.00 CELAVG     0.00 CUMTIM     5.57
HCENTR    0.0000 VCENTR   72.0000 IHORZ   3 IVERT   1 ISEED 29673167 COUNT   -1. CELTIM    0.00 CELAVG     0.00 CUMTIM     5.57
HCENTR  -24.0000 VCENTR   72.0000 IHORZ   4 IVERT   1 ISEED 10631079 COUNT   -1. CELTIM    0.00 CELAVG     0.00 CUMTIM     5.57
HCENTR  -48.0000 VCENTR   72.0000 IHORZ   5 IVERT   1 ISEED 42712927 COUNT   -1. CELTIM    0.00 CELAVG     0.00 CUMTIM     5.57
HCENTR   48.0000 VCENTR   48.0000 IHORZ   1 IVERT   2 ISEED 63176855 COUNT   -1. CELTIM    0.00 CELAVG     0.00 CUMTIM     5.57
HCENTR   24.0000 VCENTR   48.0000 IHORZ   2 IVERT   2 ISEED  4543663 COUNT   -1. CELTIM    0.00 CELAVG     0.00 CUMTIM     5.57

C  0.0   48.0 95   17.23  -17.23          2   0  2   10.800   49.200 A  0.,E  0.
   101   2.10    .97  60.3  2  30.26   0  2    1
   101   2.10    .97  64.6  9   0.00   0  2    2
D  17.23  10.80  49.20  15.13  10.80  49.20  10.75   9.96  49.11          0  2
E  SUMMARY VULNERABLE REGION    11 ITEM 2701 CELL (   0   2) NUM RAYS TO VC    3 NUM RAYS HIT VC    2 NUM RAYS HIT.LE.3 BEFORE VC    2
   SUMMARY VULNERABLE REGION    13 ITEM 3031 CELL (   0   2) NUM RAYS TO VC    3 NUM RAYS HIT VC    3 NUM RAYS HIT.LE.3 BEFORE VC    3
   SUMMARY VULNERABLE REGION    14 ITEM 3031 CELL (   0   2) NUM RAYS TO VC    3 NUM RAYS HIT VC    1 NUM RAYS HIT.LE.3 BEFORE VC    1
   SUMMARY VULNERABLE REGION    16 ITEM 3031 CELL (   0   2) NUM RAYS TO VC    3 NUM RAYS HIT VC    2 NUM RAYS HIT.LE.3 BEFORE VC    2
F  HCENTR    0.0000 VCENTR   48.0000 IHORZ   3 IVERT   2 ISEED 13261983 COUNT    1. CELTIM     .02 CELAVG     .02 CUMTIM     5.59
   HCENTR  -24.0000 VCENTR   48.0000 IHORZ   4 IVERT   2 ISEED 32171591 COUNT    1. CELTIM    0.00 CELAVG     .02 CUMTIM     5.59
   HCENTR  -48.0000 VCENTR   48.0000 IHORZ   5 IVERT   2 ISEED 36947423 COUNT    1. CELTIM    0.00 CELAVG     .02 CUMTIM     5.59
   HCENTR   48.0000 VCENTR   24.0000 IHORZ   1 IVERT   3 ISEED  7145783 COUNT    1. CELTIM    0.00 CELAVG     .02 CUMTIM     5.59

  24.0   24.0 77   87.50  -91.07          2   1  1   18.000   30.000 A  0.,E  0.
 100  13.50  16.44  34.8  2 148.00   1  1    1
 109  17.07  17.07   0.0  9   0.00   1  1    2
  87.50  18.00  30.00  74.00  18.00  30.00  74.00   6.62  30.00          1  1
SUMMARY VULNERABLE REGION     2 ITEM 1041 CELL (   1   1) NUM RAYS TO VC    3 NUM RAYS HIT VC    1 NUM RAYS HIT.LE.3 BEFORE VC    1
SUMMARY VULNERABLE REGION    11 ITEM 2701 CELL (   1   1) NUM RAYS TO VC    3 NUM RAYS HIT VC    3 NUM RAYS HIT.LE.3 BEFORE VC    3
```

Table XXXI. RIP Option Sample Printout when Main Rays are Computed by a Grid (Compressed for Display) (continued)

```
SUMMARY VULNERABLE REGION    13 ITEM 3031 CELL (    1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    3 NUM RAYS HIT.LE.3 BEFORE VC    3
SUMMARY VULNERABLE REGION    14 ITEM 3031 CELL (    1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    2 NUM RAYS HIT.LE.3 BEFORE VC    2
SUMMARY VULNERABLE REGION    15 ITEM 3031 CELL (    1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    1 NUM RAYS HIT.LE.3 BEFORE VC    1
SUMMARY VULNERABLE REGION    16 ITEM 3031 CELL (    1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    0 NUM RAYS HIT.LE.3 BEFORE VC    0
SUMMARY VULNERABLE REGION    17 ITEM 3031 CELL (    1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    1 NUM RAYS HIT.LE.3 BEFORE VC    1
SUMMARY VULNERABLE REGION    18 ITEM 3031 CELL (    1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    3 NUM RAYS HIT.LE.3 BEFORE VC    3
HCENTR    24.0000 VCENTR    24.0000 IHORZ    2 IVERT    3 ISEED 23866207 COUNT     2. CELTIM      .03 CELAVG      .03 CUMTIM      5.63

   0.0    24.0   0    92.50 -100.00           2    0   1   -10.800    13.200 A  0.,E  0.
 100   18.50   22.52   34.8   2 148.00    0   1     1
 100   26.00   26.00    0.0   9   0.00    0   1     2
  92.50 -10.80   13.20   74.00 -10.80   13.20   74.00    2.05   13.20          0   1
SUMMARY VULNERABLE REGION     2 ITEM 1041 CELL (    0    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    1 NUM RAYS HIT.LE.3 BEFORE VC    1
SUMMARY VULNERABLE REGION    11 ITEM 2701 CELL (    0    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    1 NUM RAYS HIT.LE.3 BEFORE VC    1
SUMMARY VULNERABLE REGION    13 ITEM 3031 CELL (    0    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    3 NUM RAYS HIT.LE.3 BEFORE VC    3
SUMMARY VULNERABLE REGION    14 ITEM 3031 CELL (    0    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    0 NUM RAYS HIT.LE.3 BEFORE VC    0
SUMMARY VULNERABLE REGION    15 ITEM 3031 CELL (    0    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    2 NUM RAYS HIT.LE.3 BEFORE VC    2
SUMMARY VULNERABLE REGION    16 ITEM 3031 CELL (    0    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    1 NUM RAYS HIT.LE.3 BEFORE VC    1
SUMMARY VULNERABLE REGION    17 ITEM 3031 CELL (    0    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    0 NUM RAYS HIT.LE.3 BEFORE VC    0
SUMMARY VULNERABLE REGION    18 ITEM 3031 CELL (    0    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    1 NUM RAYS HIT.LE.3 BEFORE VC    1
HCENTR     0.0000 VCENTR    24.0000 IHORZ    3 IVERT    3 ISEED 359C8023 COUNT     3. CELTIM      .02 CELAVG      .03 CUMTIM      5.65

 -24.0    24.0   0    75.83  -77.50           4   -1   1   -34.800    13.200 A  0.,E  0.
 100    1.83    2.23   34.8   2   2.06   -1   1     1
 651   23.88   24.00    5.7   2  96.12   -1   1     2
 653   23.88   24.00    5.7   2   2.06   -1   1     3
 100    3.50    3.50    0.0   9   0.00   -1   1     4
  75.83 -34.80   13.20   74.00 -34.80   13.20   74.00 -33.53   13.20         -1   1
SUMMARY VULNERABLE REGION     2 ITEM 1041 CELL (   -1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    2 NUM RAYS HIT.LE.3 BEFORE VC    2
SUMMARY VULNERABLE REGION    11 ITEM 2701 CELL (   -1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    2 NUM RAYS HIT.LE.3 BEFORE VC    2
SUMMARY VULNERABLE REGION    13 ITEM 3031 CELL (   -1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    3 NUM RAYS HIT.LE.3 BEFORE VC    3
SUMMARY VULNERABLE REGION    14 ITEM 3031 CELL (   -1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    1 NUM RAYS HIT.LE.3 BEFORE VC    1
SUMMARY VULNERABLE REGION    15 ITEM 3031 CELL (   -1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    0 NUM RAYS HIT.LE.3 BEFORE VC    0
SUMMARY VULNERABLE REGION    16 ITEM 3031 CELL (   -1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    0 NUM RAYS HIT.LE.3 BEFORE VC    0
SUMMARY VULNERABLE REGION    17 ITEM 3031 CELL (   -1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    0 NUM RAYS HIT.LE.3 BEFORE VC    0
SUMMARY VULNERABLE REGION    18 ITEM 3031 CELL (   -1    1) NUM RAYS TO VC    3 NUM RAYS HIT VC    2 NUM RAYS HIT.LE.3 BEFORE VC    2
HCENTR   -24.0000 VCENTR    24.0000 IHORZ    4 IVERT    3 ISEED 48068719 COUNT     4. CELTIM      .03 CELAVG      .03 CUMTIM      5.68
HCENTR   -48.0000 VCENTR    24.0000 IHORZ    5 IVERT    3 ISEED 63494727 COUNT     4. CELTIM     0.00 CELAVG      .03 CUMTIM      5.68
HCENTR    48.0000 VCENTR     0.0000 IHORZ    1 IVERT    4 ISEED 52812255 COUNT     4. CELTIM     0.00 CELAVG      .03 CUMTIM      5.69
HCENTR    24.0000 VCENTR     0.0000 IHORZ    2 IVERT    4 ISEED  8928567 COUNT     4. CELTIM     0.00 CELAVG      .03 CUMTIM      5.69
HCENTR     0.0000 VCENTR     0.0000 IHORZ    3 IVERT    4 ISEED 17283663 COUNT     4. CELTIM     0.00 CELAVG      .03 CUMTIM      5.69
HCENTR   -24.0000 VCENTR     0.0000 IHORZ    4 IVERT    4 ISEED 40204071 COUNT     4. CELTIM     0.00 CELAVG      .03 CUMTIM      5.69
HCENTR   -48.0000 VCENTR     0.0000 IHORZ    5 IVERT    4 ISEED 21858751 COUNT     4. CELTIM     0.00 CELAVG      .03 CUMTIM      5.69

END OF CASE    1

TIME FOR VIEW      .13 SECONDS

TOTAL TIME FOR RIP      .13 SECONDS

NUMBER OF CELLS PROCESSED          20
NUMBER OF CELLS HIT                 4
NUMBER OF CELLS WITH BURST POINT    4.
NUMBER OF CELLS MISSED             16

LEAVE RIP

END OF RUN
```

"SUMMARY VULNERABLE REGION 2 ITEM 2701 CELL (02) NUM RAYS TO VC 3 NUM RAYS HIT VC 2 NUM RAYS HIT.LE.3 BEFORE VC 2" means that vulnerable region 2 has a region identification code number of 2701; region 2 was located in the cone generated around the primary ray located in a grid cell whose horizontal matrix position is 0 and whose vertical matrix position is 2; three rays were directed toward region 2 from the burst point and two rays intersected it, and the number of rays from the burst point which intersected region 2 and had less than or equal to three regions between it and the burst point is 2. The line labeled F is printed after each primary ray and burst point is computed. It contains the information needed to start a RIP run from a previous RIP run which had been terminated due to "AN ALMOST MAX TIME ABORT." "COUNT 1. CELTIM .02 CELAVG .02 CUMTIM 5.59" means that one burst point was computed so far, the time required to compute the burst point was .02 seconds, the average time required for each burst point is .02 seconds and the time used by the run is 5.59 seconds. Table XXXII is the RIP output generated on FORTRAN unit 2 connected with the printout in Table XXXI. Figures 69 through 75 describe the data written on FORTRAN Unit 2 by the RIP option illustrated in Table XXXII. Table XXXIII is the printout generated when the "SUPPRESS PRINTER OPTION" is used (non-zero number in columns 21-30 of the Control Card for RIP) and when each primary ray is specified (non-zero number in columns 41-50 of the Control Card for RIP).

H. TESTG Option

The TESTG option is primarily used to debug the COM-GEOM description. Its purpose is to generate and print as much ray intersection data as possible. Care must be taken in selecting a ray to be printed because no jiggling of the ray's starting point occurs. Therefore, it is possible that it may be traced in the crack between two adjacent solids. If a ray is traced in the crack, the GIFT code would either compute the intersection of both solids which may cause an overlapping region error message to be printed or compute the intersection of neither solid which may cause the generation of phantom armor. Figure 76 describes the input for the TESTG option.

Table 34 contains the output from the TESTG option using the COM-GEOM description of Table I and the TESTG option data in Figure 77. The data in Table XXXIV is similar to that generated for the overlapping region error message previously described in section II.E GIFT Basics except for the sections labeled A and B. Section A presents the ray and solid intersection data. The data is similar to that contained in the other parts of the printout of the ray. "RIN" is the distance from the starting point of the ray to the entrance point of the solid. "ROUT" is the distance from the starting point of the ray to the exit point of the solid. "LOS" is the distance the ray traveled through the solid. "SURFI" and "SURFO" are the numbers of the surfaces intersected at the entrance and exit points

1-5	6-15	16-75	76-80
NOAA	DATE	ITITLE	

FORMAT (I5,7A10)

NOAA - Number of views.

DATE - Date tape was written.

ITITLE - COM-GEOM description title.

Figure 69. Title Line of RIP Output on FORTRAN Unit 2

1-20	21-40	41-50	51-60	61-70	71-80
A	E	TCENTR(1)	TCENTR(2)	TCENTR(3)	CELSIZ

FORMAT (2E20.8,4E10.3)

A - Azimuth angle in degrees.

E - Elevation angle in degrees.

TCENTR(I) - x, y, z coordinate of target center

CELSIZ - Grid cell size in view plane.

Figure 70. View Line of RIP Output on FORTRAN Unit 2

1-6	7-13	14-16	17-24	25-32	33-40	41-43	44-47	48-50	51-59	60-68	69-70	71-74	75-76	77-80
HCENTR	VCENTR	IHIV	DFIRST	DLAST		NCOMP	IH	IV	H	V	' A'	A	',E'	E

FORMAT (F6.1,F7.1,I3,2F8.2,8X,I3,I4,I3,2F9.3,1X,
1HA,F4.0,1H,1HE,F4.0)

HCENTR - Horizontal coordinate of center of grid cell. If the horizontal coordinate is equal to 999.9, this is the end of the view.

VCENTR - Vertical coordinate of center of grid cell.

IHIV - Two digit random number representing the location within the grid cell where the ray intersects the view plane.

DFIRST - Distance from first intersection with the ray to the view plane.

DLAST - Distance from last intersection with the ray to the view plane.

NCOMP - Number of components intersected by ray.

IH - Vertical cell matrix position of the grid cell.

H - Horizontal coordinate of the projection of the starting point of the ray onto the view plane.

V - Vertical coordinate of the projection of the starting point of the ray onto the view plane.

A - Azimuth angle in degrees.

E - Elevation angle in degrees.

Figure 71. Cell Identification Line of RIP Output on FORTRAN Unit 2

1-4	5-11	12-18	19-24	25-27	28-34	35-38	39-41	42-46	47-80
ITEM(I)	CLOS(I)	CNORMI(I)	CANGI(I)	KSPAC(I)	SLOS(I)	IH	IV	I	

FORMAT (I4,2F7.2,F6.1,I3,F7.2,I4,I3,I5)

ITEM - Item code number.

CLOS(I) - Distance ray travels through item.

CNORMI(I) - Normal distance through item from entrance point.

CANGI(I) - Angle between normal vector and ray at entrance point.

KSPAC(I) - Code for air space following item.

SLOS(I) - Distance ray travels through air space.

IH - Horizontal matrix position of grid cell.

IV - Vertical matrix position of grid cell.

I - Cumulative number of items.

Figure 72. Ray Intersection Lines of the RIP Output of FORTRAN Unit 2

1-7	8-14	15-21	22-28	29-35	36-42	43-49	50-56	57-63	64-73	74 76	77-80
AA(1)	AA(2)	AA(3)	B(1)	B(2)	B(3)	C(1)	C(2)	C(3)	IH	IV	

FORMAT (9F7.2,I10,I3)

AA(I) - The point intersection of ray with the exterior surface of the spalling component. If AA(I) is equal to 999.99, no burst point is computed.

B(I) - The point from which spall rays are traced.

C(I) - The point of intersection of a normal vector from point AA(I) with the interior surface of the spalling component.

IH - Horizontal matrix position of the grid cell.

IV - Vertical matrix position of the grid cell.

Figure 73. Burst Point Header Line of the RIP Output On FORTRAN Unit 2

1-5	6-12	13-22	23-32	33-42	43-52	53-57	58-61	62-65
IREG	IDENT	PC(1)	PC(2)	PC(3)	A	MREG	IHORZ	IVERT

FORMAT (I5,I7,4F10.2,I5,2I4)

IREG - Region number. If the region number is equal to "54321", there are no more vulnerable regions for this burst point.

IDENT - Item code number for region.

PC(I) - Point where the spalling ray enters the region.

A - Presented area of region associated with ray.

MREG - Number of regions between burst point and vulnerable region.

IHORZ - Horizontal matrix position of the grid cell.

IVERT - Vertical matrix position of the grid cell.

Figure 74. Vulnerable Region Lines of the RIP Output on FORTRAN Unit 2

1-5	6-10	11-17	18-24	25-29	30-32	33-39	40-80
COMP(1,I)	COMP(2,I)	COMP(3,I)	COMP(4,I)	COMP(5,I)	COMP(6,I)	COMP(7,I)	

FORMAT (2I5,2F7.1,F5.1,I3,F7.1)

COMP(1,I) - Region number .

COMP(2,I) - Item code number for region.

COMP(3,I) - Distance ray travels through region.

COMP(4,I) - Distance normal vector travels through the region from the entrance point of the spalling ray.

COMP(5,I) - Angle between normal vector and the ray.

COMP(6,I) - Code for air space following region.

COMP(7,I) - Distance ray travels through air space.

Figure 75. Shielding Region Lines of the RIP Output on FORTRAN Unit 2

Table XXXII. RIP Option Sample Output on FORTRAN Unit 2

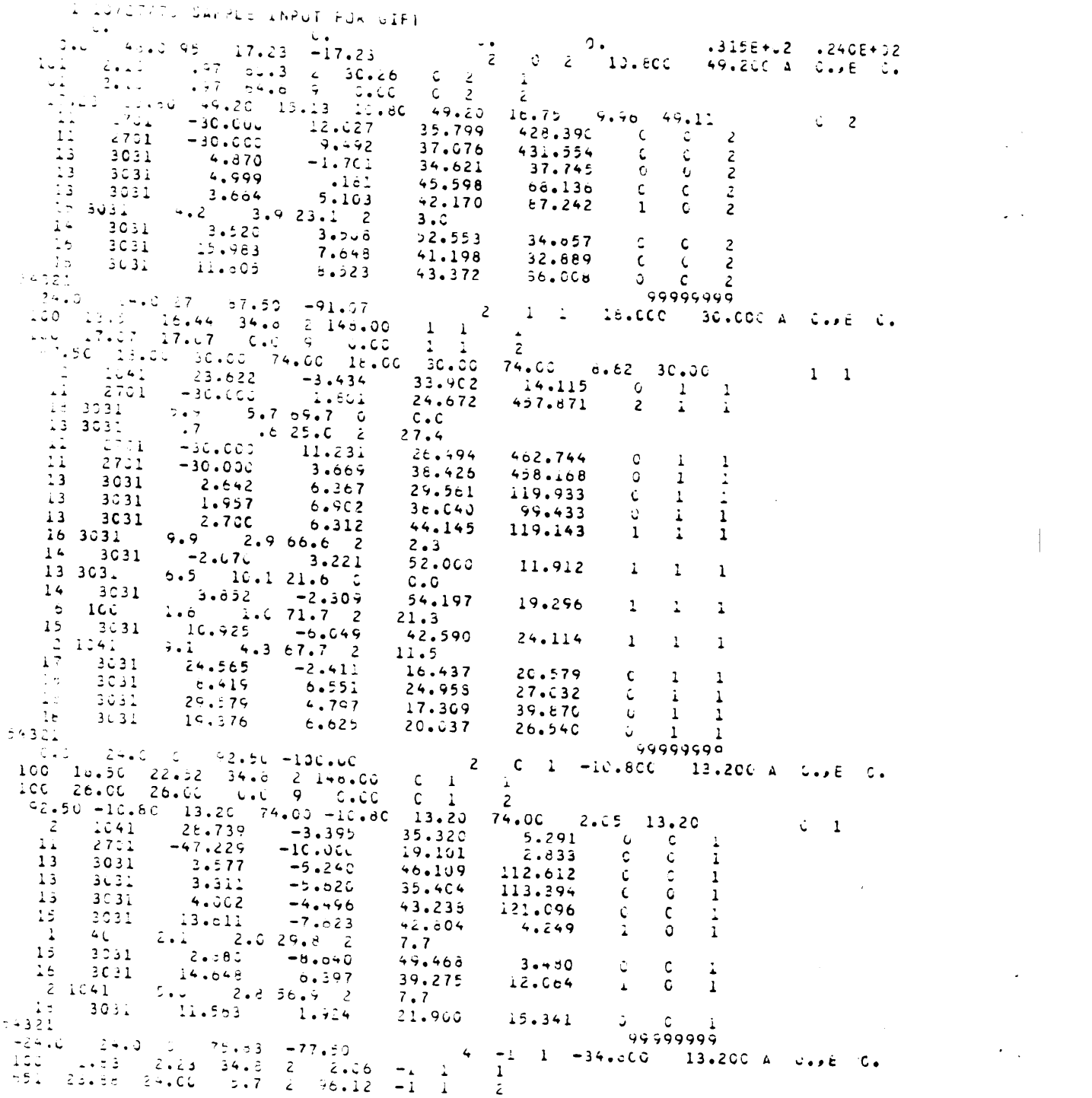


Table XXXII. RIP Option Sample Output on FORTRAN Unit 2 (Con't)

```
653  23.88  24.00    5.7  2   2.00  -1  1     3
100   3.50   3.50    0.0  9   0.00  -1  1     4
 75.33 -34.80  13.20  74.00 -34.80  13.20  74.00 -33.53  13.20          -1  1
   2   1041     34.641     -1.554     35.986     44.086     1  -1    1
   7   051     8.3   24.0 53.2  2   44.8
   2   1041     30.014     -1.186     36.704     33.419     1  -1    1
   7   051     9.2   24.0 51.8  2   48.6
  11   2701    -30.000    -10.512     35.873    413.541     1  -1    1
   7   651    22.8   24.0 22.4  2   82.9
  11   2701    -30.000      4.205     37.217    392.961     2  -1    1
   7   051    17.5   24.0 28.8  2   60.1
  13 3031     4.4   14.1 55.2  2   29.4
  13   3031       3.327     -5.599     35.674    145.360     1  -1    1
   7   651    16.1   24.0 33.7  2   61.1
  13   3031       4.653     -2.744     51.528    137.605     1  -1    1
   7   051    15.4   24.0 45.3  2   67.3
  13   3031       4.968       .853     26.835    131.078     1  -1    1
   7   651    12.0   24.0 32.5  2   63.8
  14   3031       1.902     -2.799     52.000     22.302     2  -1    1
   7   651    15.9   24.0 44.4  2   66.3
  13 3031     2.9   10.0 26.3  0    0.0
  18   3021       7.556       2.154     24.878     62.967     1  -1    1
   7   651    11.7   24.0 33.2  2   62.8
  18   3031      11.172       4.132     24.827     29.655     1  -1    1
   7   051    10.6   24.0 35.7  2   61.8
54321                                                  99999999
 999.9                                                                  END
```

Table XXXIII. RIP Option Sample Printout When Primary Rays are Computed Individually and Suppress Print Option is Specified

```
ENTER RIP

NUMBER OF ASPECT ANGLES (MAIN RAYS) FOR RIP     1

NUMBER OF RAYS PER VULNERABLE COMPONENT     3

SUPPRESS PRINTER OUTPUT OPTION IS SPECIFIED

MAIN RAY OPTION IS SPECIFIED

OPTION SET TO SUPPRESS NORMALS

MAXIMUM TIME FOR RIP     60

START POINT      0.00000      0.00000      0.00000
AZIMUTH          0.000
ELEVATION      -90.000
HCENTR     0.0000 VCENTR     0.0000 IHORZ    0 IVERT    0 ISEED 40807307 COUNT     1. CELTIM      .03 CELAVG      .03 CUMTIM      5.56

TOTAL TIME FOR RIP       .03 SECONDS

NUMBER OF CELLS PROCESSED            1
NUMBER OF CELLS HIT                  1
NUMBER OF CELLS WITH BURST POINT     1.
NUMBER OF CELLS MISSED               0

LEAVE RIP
```

1-10	11-20	21-30	31-40	41-50	51-60	61-70	71	72-75	76-80
IRAY	XB(1)	XB(2)	XB(3)				NORM	NOSOL	NOREG
IRAY = 1				XE(1)	XE(2)	XE(3)			
IRAY = 2				WB(1)	WB(2)	WB(3)			
IRAY = 3				A	E				

FORMAT (I10,6F10,I1,I4,I5)

IRAY - Specify a code number which indicates the method of describing the ray. If IRAY is less than or equal to 0, end of TESTG data. If IRAY equals 1, track a ray between two points. If IRAY equals 2, track a ray from a starting point with a direction specified by a unit vector. If IRAY equals 3, track a ray from a starting point with a direction specified by azimuth and elevation angles

XB(I) - Specify the starting point of the ray.

XE(I) - Specify the end point of the ray.

WB(I) - Specify a unit vector giving the ray direction.

A - Azimuth angle in degrees.

E - Elevation angle in degrees.

NORM - If not zero, computes obliquity angles and normals.

NOSOL - If not zero, do not print intersections of the ray with solids.

NOREG - If not zero, do not print intersections of the ray with the regions.

Figure 76. Input for TESTG Option

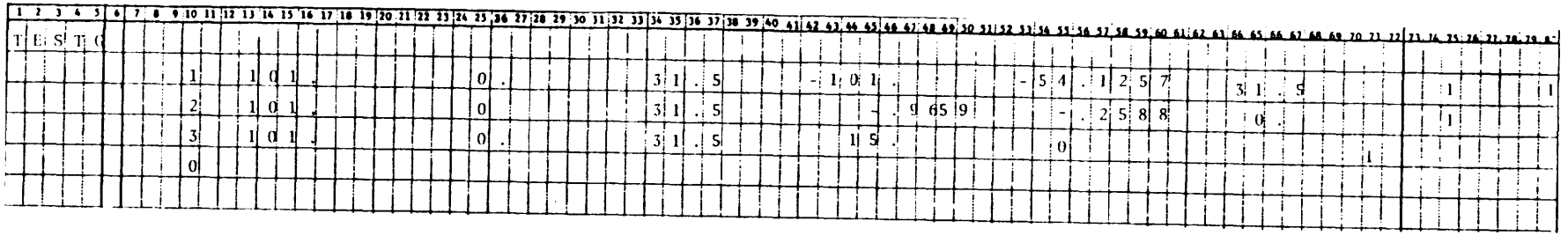


Figure 77. Sample Input for TESTG Design

Table XXXIV. Sample Output for TESTG Option
(Compressed for Display)

```
ENTER TESTG


 START POINT   101.00000     0.00000     31.50000
 END   POINT  -101.00000   -54.12570     31.50000

 STARTING POINT OF RAY       101.00000      0.00000     31.50000
 DIRECTION COSINES OF RAY       -.96593      -.25882      0.00000

 NUMBER OF INTERSECTIONS OF RAY AND ALL COMPONENTS    2
                                REGION (IN)    REGION (OUT)
                                   SOLID          SOLID                                                                  SPACE
 ITEM  DIST IN    DIST OUT     LOS          SURF           SURF        X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT      LOS
  100  15.05946   27.95255   12.90    3   3   4    6  20   2     86.4588   -3.8966   31.5000   74.0000   7.2315   31.5000   2 107.28
  100 135.2297   139.0934    3.86    6  20  -3    6   6  -3    -29.6227  -35.0000   31.5000  -33.3594  -36.0000   31.5000   9   0.00

 NUMBER OF INTERSECTIONS OF RAY AND ALL REGIONS IS    4
  REGION  ITEM    DIST IN    DIST OUT     LOS      SOL SURF   SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
     3     100   15.05464   26.91718   11.8625    3   4      3   -1     86.4583   -3.8964   31.5000   75.0000   -6.9667   31.5000
     6     100   26.91718   27.95246    1.0353    6   2     20    2     75.0000   -6.9667   31.5000   74.0000   -7.2346   31.5000
    20       0   27.95246  135.22970  107.2772   20   2     20   -3     74.0000   -7.2346   31.5000  -29.6219   -35.0000  31.5000
     6     100  135.22970  139.09341    3.8637   20  -3      6   -3    -29.6219  -35.0000   31.5000  -33.3519   -36.0000  31.5000
```

Table XXXIV. Sample Output for TESTG Option (Compressed for Display) (Con't)

```
START POINT          101.00000      0.00000     31.50000
DIRECTION COSINES      -.96593      -.25881      0.00000

STARTING POINT OF RAY      101.00000      0.00000     31.50000
DIRECTION COSINES OF RAY      -.96593      -.25881      0.00000

NUMBER OF INTERSECTIONS OF RAY AND ALL COMPONENTS    2
                              REGION (IN)   REGION (OUT)
                                  SOLID         SOLID                                                                  SPACE
ITEM  DIST IN    DIST OUT     LOS          SURF          SURF        X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT      LOS
 100  15.0546    27.9524    12.90    3    3   4    6   20   2     86.458    -3.896    31.500    74.000    -7.234    31.500   2 107.28
 100 135.2355   139.0994     3.86    6   20  -3    6    6  -3    -29.628   -35.000    31.500   -33.360   -36.000    31.500   9   0.00

NUMBER OF INTERSECTIONS OF RAY AND ALL REGIONS IS    4
 REGION  ITEM    DIST IN    DIST OUT     LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
      3   100   15.05459   26.91710   11.8625     3    4    3   -1    86.4583   -3.8962   31.5000   75.0000   -6.9664   31.5000
      6   100   26.91710   27.95237    1.0353     6    2   20    2    75.0000   -6.9664   31.5000   74.0000   -7.2343   31.5000
     20     0   27.95237  135.23553  107.2832    20    2   20   -3    74.0000   -7.2343   31.5000  -29.6279  -35.0000   31.5000
      6   100  135.23553  139.09940    3.8639    20   -3    6   -3   -29.6279  -35.0000   31.5000  -33.3601  -36.0000   31.5000

NUMBER OF REGIONS INTERSECTED      3

REGION      3     ITEM    100     SPACE   0     DESCRIPTION    BODY-FRONT          3                    ARB5
        UP SOLID TYP       RIN          ROUT         LOS     SURFI SURFO      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
         +     3 ARB     15.05459    26.91710   11.8625      4     1     86.4583   -3.8962   31.5000   75.0000   -6.9664   31.5000

NUMBER OF INTERSECTIONS OF RAY AND REGION    3 IS   1
   REGION ITEM   DIST IN    DIST OUT     LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
        3  100   15.05459   26.91710   11.8625     3    4    3   -1    86.4583   -3.8962   31.5000   75.0000   -6.9664   31.5000

REGION      6     ITEM    100     SPACE   0     DESCRIPTION    BODY-CENTER         6-20-19-7-8-9-10 RPP
        UP SOLID TYP       RIN          ROUT         LOS     SURFI SURFO      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
         +     6 RPP     26.91710   139.09940  112.1823      2     3     75.0000   -6.9664   31.5000  -33.3601  -36.0000   31.5000
         -    20 BOX     27.95237   135.23553  107.2832      2     3     74.0000   -7.2343   31.5000  -29.6279  -35.0000   31.5000

NUMBER OF INTERSECTIONS OF RAY AND REGION    6 IS   2
   REGION ITEM   DIST IN    DIST OUT     LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
        6  100   26.91710   27.95237    1.0353     6    2   20    2    75.0000   -6.9664   31.5000   74.0000   -7.2343   31.5000
        6  100  135.23553  139.09940    3.8639    20   -3    6   -3   -29.6279  -35.0000   31.5000  -33.3601  -36.0000   31.5000

REGION     20     ITEM      0     SPACE   2     DESCRIPTION    INSIDE AIR (BODY)  20                   BOX
        UP SOLID TYP       RIN          ROUT         LOS     SURFI SURFO      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
         +    20 BOX     27.95237   135.23553  107.2832      2     3     74.0000   -7.2343   31.5000  -29.6279  -35.0000   31.5000

NUMBER OF INTERSECTIONS OF RAY AND REGION   20 IS   1
   REGION ITEM   DIST IN    DIST OUT     LOS      SOL SURF  SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
       20    0   27.95237  135.23553  107.2832    20    2   20   -3    74.0000   -7.2343   31.5000  -29.6279  -35.0000   31.5000
```

Table XXXIV. Sample Output for TESTG Option (Compressed for Display) (Con't)

```
START POINT    101.00000      0.00000     31.50000
AZIMUTH         15.000
ELEVATION        0.000

STARTING POINT OF RAY       101.00000      0.00000     31.50000
DIRECTION COSINES OF RAY      -.96593      -.25882      0.00000

NUMBER OF INTERSECTIONS OF RAY AND ALL COMPONENTS     2
                                  REGION (IN)   REGION (OUT)
                                       SOLID         SOLID                                                                SPACE
ITEM  DIST IN    DIST OUT     LOS          SURF          SURF        X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT      LOS
 100  15.0546    27.9525    12.90    3   3   4    6   20   2     66.458    -3.896    31.500    74.000    -7.235    31.500   2 107.28
 100 135.2296   139.0933     3.86    6  20  -3    6    6  -3    -29.622   -35.000    31.500   -33.354   -36.000    31.500   9   0.00

NUMBER OF INTERSECTIONS OF RAY AND ALL REGIONS IS     4
 REGION  ITEM     DIST  IN     DIST OUT     LOS      SOL SURF   SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
      3   100    15.05464    26.91718   11.8625     3    4     3   -1     86.4583   -3.8964   31.5000   75.0000   -6.9667   31.5000
      6   100    26.91718    27.95246    1.0353     6    2    20    2     75.0000   -6.9667   31.5000   74.0000   -7.2346   31.5000
     20     0    27.95246   135.22962  107.2772    20    4    20   -3     74.0000   -7.2346   31.5000   -29.6218  -35.0000   31.5000
      6   100   135.22962   139.09332    3.8637    20   -3     6   -3    -29.6218  -35.0000   31.5000   -33.3538  -36.0000   31.5000

A  INTERSECTIONS OF ALL SOLIDS AND RAY NUMBER   7287
            SOLID TYP       RIN          ROUT         LOS      SURFI SURFO      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
               3 ARB      15.05464     26.91718    11.8625       4     1     86.4583   -3.8964   31.5000   75.0000   -6.9667   31.5000
               6 RPP      26.91718    139.09332   112.1761       2     3     75.0000   -6.9667   31.5000   -33.3538  -36.0000   31.5000
              20 BOX      27.95246    135.22962   107.2772       2     3     74.0000   -7.2346   31.5000   -29.6218  -35.0000   31.5000

NUMBER OF REGIONS INTERSECTED      3

REGION      3     ITEM    100     SPACE    0     DESCRIPTION   BODY-FRONT          3                  ARBS
        OP SOLID TYP       RIN          ROUT         LOS      SURFI SURFO      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
         +     3 ARB      15.05464     26.91718    11.8625       4     1     86.4583   -3.8964   31.5000   75.0000   -6.9667   31.5000

NUMBER OF INTERSECTIONS OF RAY AND REGION     3 IS    1
   REGION ITEM    DIST  IN     DIST OUT     LOS      SOL SURF   SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
        3  100    15.05464    26.91718   11.8625     3    4     3   -1     86.4583   -3.8964   31.5000   75.0000   -6.9667   31.5000

REGION      6     ITEM    100     SPACE    0     DESCRIPTION   BODY-CENTER          6-20-19-7-8-9-10 RPP
        OP SOLID TYP       RIN          ROUT         LOS      SURFI SURFO      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
         +     6 RPP      26.91718    139.09332   112.1761       2     3     75.0000   -6.9667   31.5000   -33.3538  -36.0000   31.5000
         -    20 BOX      27.95246    135.22962   107.2772       2     3     74.0000   -7.2346   31.5000   -29.6218  -35.0000   31.5000

NUMBER OF INTERSECTIONS OF RAY AND REGION     6 IS    2
   REGION ITEM    DIST  IN     DIST OUT     LOS      SOL SURF   SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
        6  100   26.91718    27.95246    1.0353     6    2    20    2     75.0000   -6.9667   31.5000   74.0000   -7.2346   31.5000
        6  100  135.22962   139.09332    3.8637    20   -3     6   -3    -29.6218  -35.0000   31.5000   -33.3538  -36.0000   31.5000

REGION     20     ITEM      0     SPACE    2     DESCRIPTION   INSIDE AIR (BODY)  20                 BOX
        OP SOLID TYP       RIN          ROUT         LOS      SURFI SURFO      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
         +    20 BOX      27.95246    135.22962   107.2772       2     3     74.0000   -7.2346   31.5000   -29.6218  -35.0000   31.5000

NUMBER OF INTERSECTIONS OF RAY AND REGION    20 IS    1
   REGION ITEM    DIST  IN     DIST OUT     LOS      SOL SURF   SOL SURF      X IN      Y IN      Z IN      X OUT     Y OUT     Z OUT
       20    0   27.95246   135.22962  107.2772    20    2    20   -3     74.0000   -7.2346   31.5000   -29.6218  -35.0000   31.5000

B  SEQ  ITEM      LOS    NORM I    ANG I    NORM O   ANG O   SPACE      SEGS
    1   100     12.90     15.17     37.5     12.46    15.0       2    107.28
    2   100      3.86      1.00     75.0      1.00    75.0       9      0.00

TOTAL TIME FOR TESTG      .040 SECONDS

LEAVE TESTG
```

of the solid in the coordinate system of the COM-GEOM description. The section labeled B is printed when column 71 of TESTG Input Card is not zero. "NORM I" is the distance a vector normal to the surface at the entrance point of the ray travels through the component. "ANG I" is the angle between the normal vector and the ray. "NORMO" is the distance a vector normal to the surface at the exit point of the ray travels through the component. "ANG O" is the angle between the normal vector and the ray.

I. VOLUME Option

The volume option computes the volumes of regions. The volumes of air regions may not be accurate because this option does not subtract the allowable overlapping regions from the region defining the air. Therefore, the volume of air in a COM-GEOM description may appear to be much larger than actually exists. Figures 78 and 79 explain the input for the VOLUME option.

Table XXXV contains the output from the VOLUME option using the COM-GEOM description in Table I and the data for the VOLUME option in Figure 80. The portion of the VOLUME output with the header line "REGION... DESCRIPTION" is a table which contains the volumes and center of volumes for each region. The center of volume of the region is the location in the COM-GEOM description coordinate system of the point where the sum of all distances from the center of volume times a constant small incremental volume is zero or the center of gravity of a uniform dense region.

"TOTAL VOLUME 497241.55 IN.**3" and "CENTER OF VOLUME -4.9907 .000 30.2458 IN" means that the total volume for those regions selected is 497241.55 cubic inches and the center of volume of those regions is x = 4.9907, y = 0, and z = 30.2458 inches. The total volume is in error since it includes the volume of two regions defined as air spaces which have not subtracted the volume of the solid regions contained in them.

The second portion of the printout of Table XXXV is generated when item codes (region, identification codes) are chosen. The portion containing the volumes for each region is then ordered by item code. The total volume and the center of volume include only these five regions.

1-2	3-4	5-10	11-20	21-80
TGTUN	VOLUN		CELSIZ	

FORMAT (2A2,6X,10.0)

TGTUN - Specify the units of which the target is described.

VOLUN - Specify the units in which the volumes are to be printed.

CELSIZ - Specify the grid cell size.

Figure 78. Control Card for VOLUME Option

1-6	7-10	11-15	16-20	•••	71-75	76-80
'REGION'		CARD(1)	CARD(2)	•••	CARD(13)	CARD(14)
'ITEM'						

FORMAT (A6,4X,4A5)

"REGION" - List regions whose volumes are computed.

"ITEM" - List item codes for regions whose volumes are computed.

CARD(I) - Specify which regions or item codes whose volumes are to be computed. Integer numbers or code words are allowed. Allowable code words are:
"ALL" - Compute the volume for all regions.
"THRU" - Through, "REGION 100 THRU 150" means compute volumes of regions 100 through 150.
"END" - Last region number, "REGION 100 THRU END" means compute volumes of regions 100 through the last region.

Figure 79. List Card for VOLUME Option

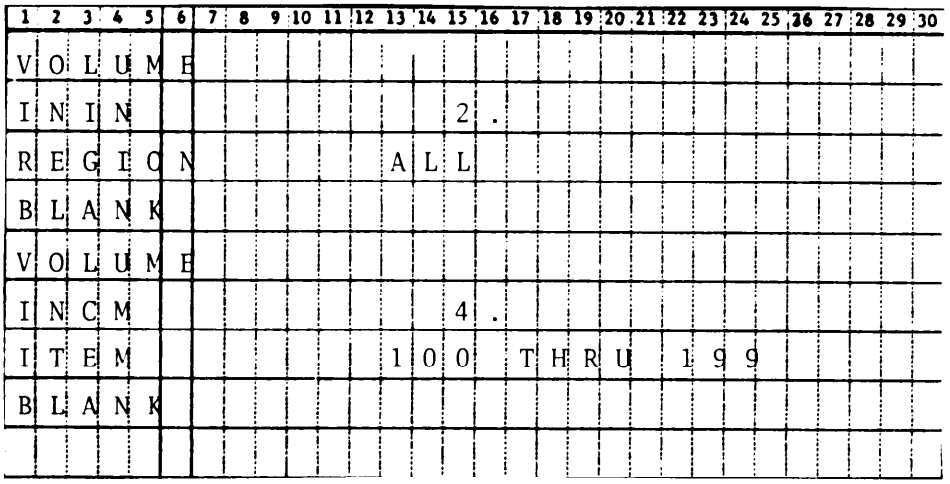


Figure 80. Sample Input for VOLUME Option

Table XXXV. Sample Output for Volume Option
(Compressed for Display)

ENTER VOLUME

CELL SIZE 2.00 IN.

REGION	ITEM	SPACE	VOLUME (IN.**3)	CENTER OF VOLUME (IN.)			DESCRIPTION		
1	40	0	201.76342	21.50000	.00000	37.00000	STEERING WHEEL	1-2	TOR
2	1041	0	380.57122	26.01488	.00000	36.86111	STEERING SHAFT	2	ARB4
3	100	0	22930.56000	80.89261	-.00000	25.79880	BODY-FRONT	3	ARB5
4	100	0	35886.72000	-83.91453	.00000	25.01841	BODY-REAR	4	ARB8
5	101	0	2270.35230	-.00000	-.00000	55.07886	BUBBLE	5-6-19	ELL
6	100	0	24382.17735	.00000	0.00000	43.38557	BODY-CENTER	6-20-19-7-8-9-10	RPP
7	651	0	3645.81137	60.00000	-32.00000	12.00000	WHEEL RIGHT FRONT	7	RCC
8	652	0	3645.81137	60.00000	32.00000	12.00000	WHEEL LEFT FRONT	8	RCC
9	653	0	3645.81137	-60.00000	-32.00000	12.00000	WHEEL RIGHT REAR	9	RCC
10	654	0	3645.81137	-60.00000	32.00000	12.00000	WHEEL LEFT REAR	10	RCC
11	2701	0	27200.00000	-50.00000	0.00000	29.17648	ENGINE	11-12	ARS
12	111	0	0.00000	0.00000	0.00000	0.00000	DUMMY REGION	0	RAW
13	3031	0	2838.08897	-.05423	.00001	38.86879	MAN-TORSO	13-15-16-17-18	REC
14	3031	0	359.50503	.00000	0.00000	53.43510	MAN-HEAD	14-13	SPH
15	3031	0	255.33687	7.52169	-7.50000	44.49744	MAN-ARM	15	TEC
16	3031	0	255.33687	7.52169	7.50000	44.49744	MAN-ARM	16	TEC
17	3031	0	733.30911	11.58838	-4.50000	21.90647	MAN-LEG	17	TRC
18	3031	0	733.30911	11.58838	4.50000	21.90647	MAN-LEG	18	TRC
19	0	3	11991.27525	.00000	.00000	52.16324	INSIDE AIR (BUBBLE)		ELL1
20	0	2	352240.00000	0.00000	0.00000	30.00001	INSIDE AIR (BODY)	20	BOX

TOTAL VOLUME 497241.55 IN.**3
CENTER OF VOLUME -4.9907 .0000 30.2458 IN.

TOTAL TIME FOR VOLUME .462 SECONDS

LEAVE VOLUME

Table XXXV. Sample Output for Volume Option (Compressed for Display) (Con't)

```
ENTER VOLUME

CELL SIZE  4.00 IN.
```

ITEM	REGION	VOLUME (CM.**3)	CENTER OF VOLUME (IN.)			DESCRIPTION		
100	3	331873.44206	81.73238	-.00000	25.22185	BODY-FRONT	3	ARB5
100	4	536761.55873	-84.72626	.00000	24.38688	BODY-REAR	4	ARB8
100	6	94950.53978	0.00000	0.00000	30.00001	BODY-CENTER	6-20-19-7-8-9-10	RPP
101	5	40648.06593	-.00000	-.00000	55.73457	BUBBLE	5-6-19	ELL
111	12	0.00000	0.00000	0.00000	0.00000	DUMMY REGION	0	RAW

```
TOTAL VOLUME        994233.61 CM.**3
CENTER OF VOLUME     -18.4595       -.0000      26.4268 IN.

TOTAL TIME FOR VOLUME      .062 SECONDS

LEAVE VOLUME

END OF RUN
```

J. XSECT Option

The XSECT option produces printer and plotter plots of the intersection of a plane and the COM-GEOM description. The XSECT option is particularly useful in plotting the thickness and placement of components in the COM-GEOM description. The plotted thicknesses of components are more accurate using the XSECT option than those obtained by using the cross section option of the PICTUR option. Figures 81 through 84 describe the input for the XSECT option.

Table XXXVI depicts the printout generated by the XSECT option using the Sample Target contained in Table I and the XSECT option data in Figure 85. The portion of the printout labeled A defines the rays and the size of the rectangle in the plane in which the target is displayed. "DIRECTION COSINES OF RAYS" are the x, y, and z components of a normalized vector parallel to the rays which are traced through the COM-GEOM description. "DIRECTION COSINES OF STARTING PTS" are the x, y, and z components of a normalized vector which is parallel to the line on which the starting points of the rays lie. The "HORIZONTAL" and "VERTICAL DISTANCE" defined the size of the rectangle in the plane in which the target is displayed.

The section with the heading "OPTION SET TO PLOT ON CALCOMP" define the parameters associated with the plotter graphics. "UPPER LEFT CORNER","LOWER LEFT CORNER", and "LOWER RIGHT CORNER" is the x, y, and z coordinates of the COM-GEOM description which are located in their respective corners. "MESH SIZE" is the distance between adjacent rays or the distance on the target between plotted points. It is a measure of the accuracy of the plot. With the scale equal to 25, the distance between points on the plot is 1.25 divided by 25 or .05 inches.

The section of the printout with the heading "OPTION SET TO PLOT ON PRINTER" defines the parameters associated with the plot on the printer. The "UPPER RIGHT CORNER", "UPPER LEFT CORNER", and "LOWER LEFT CORNER" are the x, y, and z of the points in the COM-GEOM description which are represented by the upper right (B), upper left (C) and lower left (D) corners of the printer plot. The "SCALE PER INCH OF PAGE" may not be the same as the scale requested if a plotter plot is requested. It is readjusted so that distance between the rays used to generate the printer plot is an integer multiple of the distance between rays used to generate the plotter plot. In the example, the "VERTICAL MESH" which represents the distance between rays for the printer is 5.00 and the "MESH SIZE (for plotter plot) is 1.25, therefore, the integer multiple is 4. The "HORIZONTAL MESH" and "VERTICAL MESH" is horizontal and vertical dimensions of a portion of the COM-GEOM description that the printer character represents. The printer in the example is set to six lines per vertical inch. The variable NVLPI in subroutine XSECT would have to be changed if the printer was set to any other value.

1-10	11-20	21-30	31-40	41-80
NXSECT	ITAPE	NFILE	MAXERR	

FORMAT (8I10)

NXSECT - Specify the number of cross sections.

ITAPE - If not zero, write the computed points on FORTRAN Unit 2.

NFILE - Specify the number of files to skip before writing on FORTRAN Unit 2.

MAXERR - Specify the maximum number of overlap errors that will be tolerated for each cross section (Default = 25).

Figure 81. Control Card for XSECT Option

1-10	11-20	21-30	31-40	41-80
SCALE	NOPPTR	ICLCMP	IDLKP	

FORMAT (F10.4,I10)

SCALE - Specify scale for plotting on one inch of graph.

NOPPTR - If not zero, do not plot cross section on printer.

ICLMP - If not zero, plot cross section on plotter.

IDLKP - If not zero, plot only selected regions.

Figure 82. Cross Section Card for XSECT Option

1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64	65-72	73-80
P(1)	P(2)	P(3)	P(4)	P(5)	P(6)	P(7)	P(8)	P(9)	

FORMAT (9F8.0)

P(1-3) - Specify the x, y, and z coordinate of the point in the upper left corner on plotter of cross section.

P(4-6) - Specify the x, y, and z coordinate of the point in the lower left corner on plotter of cross section.

P(7-9) - Specify the x, y, and z coordinate of the point in the lower right corner on plotter of cross section.

Figure 83. Plane Card for XSECT Option

1-6	7-10	11-15	16-20	...	71-75	76-80
IDH		NKARD(1)	NKARD(2)	...	NKARD(13)	NKARD(14)

FORMAT (A6,4X,14A5)

IDH - If "KEEP", the regions listed are those to remain in the cross section. If "DELETE", the regions listed are those not to be in the cross section (Default = "KEEP")

NKARD(I) - Specify the regions to be or not to be in the cross section. Region numbers or code words are allowed. Allowable code words are:
"THRU" = Through, "100 THRU 150" means regions 100 through 150 are to be considered.
"END" - Last region number, "100 THRU END" means regions 100 through the last region are to be considered.

Repeat as many times as needed to list all the regions. A blank card is needed to signal end of the list.

Figure 84. Delete Selected Regions Card for XSECT Option (Optional, read if IDLKP of Control Card not zero)

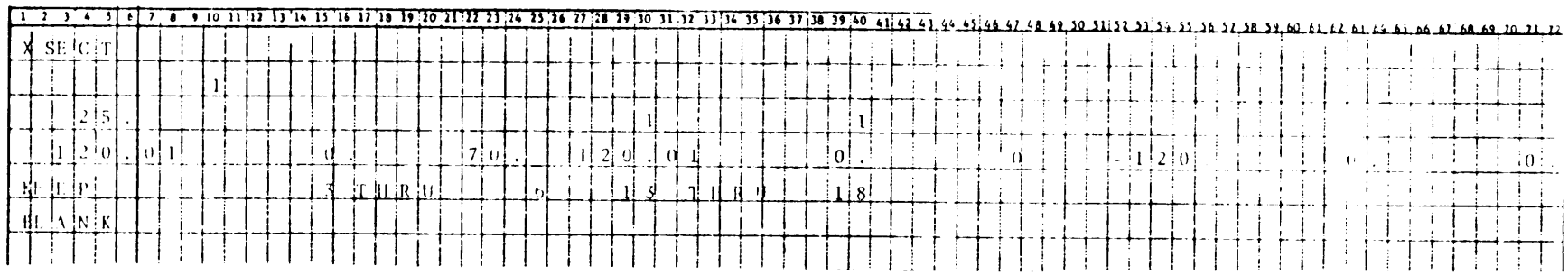


Figure 85. Sample Input for XSECT Option

Table XXXVI. Sample Output for XSECT Option
(Compressed for Display)

```
ENTER CROSS SECTION ROUTINE

NUMBER OF CROSS SECTIONS          1


A  DIRECTION COSINES OF RAYS          0.0000     0.0000     1.0000
   DIRECTION COSINES OF START PTS    -1.0000     0.0000     0.0000
   HORIZONTAL DISTANCE      240.01
   VERTICAL DISTANCE         70.00

OPTION SET TO DELETE SELECTED REGIONS

                        KEEP   REGIONS
              3 THRU     6    13 THRU   18


OPTION SET TO PLOT ON CALCOMP
UPPER LEFT CORNER         120.01        0.00       70.00
LOWER LEFT CORNER         120.01        0.00        0.00
LOWER RIGHT CORNER       -120.00        0.00        0.00
HORIZONTAL PAGE SIZE       9.00
VERTICAL PAGE SIZE         2.80
SCALE IS                  25.00
MESH SIZE                  1.25

OPTION SET TO PLOT ON PRINTER
UPPER RIGHT CORNER        120.01        0.00       70.00
UPPER LEFT CORNER         120.01        0.00        0.00
LOWER LEFT CORNER        -120.00        0.00        0.00
NUMBER OF HORZ COLUMNS        24
NUMBER OF VERT COLUMNS        48
SCALE PER INCH OF PAGE     30.00
HORIZONTAL MESH             3.00
VERTICAL MESH               5.00
```

Table XXXVI. Sample Output for XSECT Option
(Compressed for Display) (Con't)

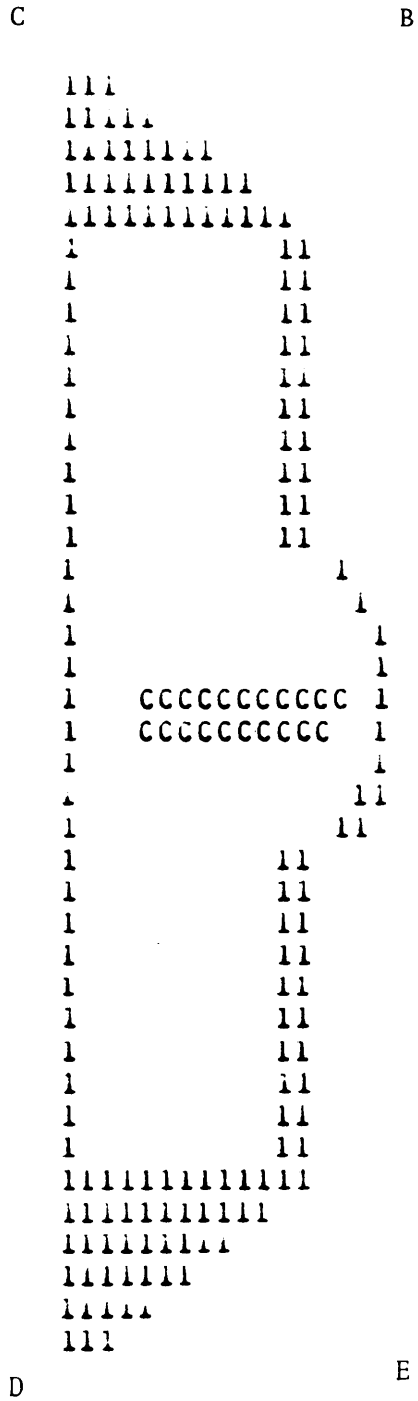
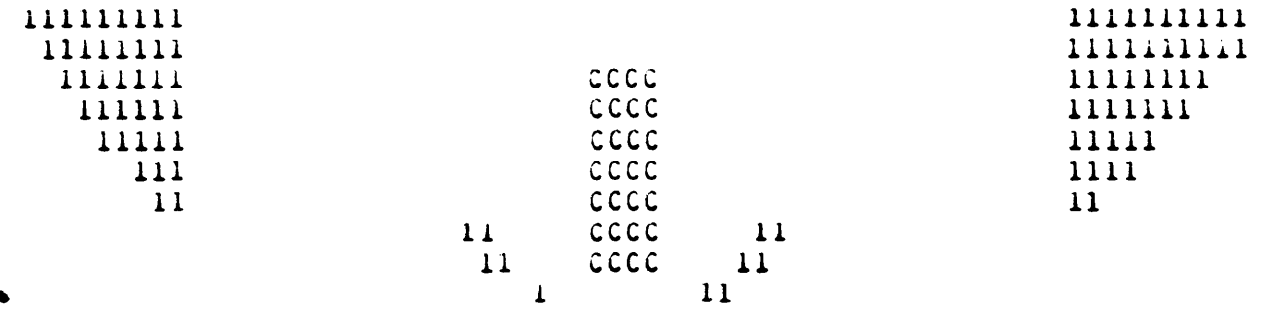


Table XXXVI. Sample Output for XSECT Option
(Compressed for Display)(Con't)

```
OPTION SET TO PLOT ON PRINTER
UPPER RIGHT CORNER          -120.00        0.00        0.00
UPPER LEFT CORNER            120.01        0.00        0.00
LOWER LEFT CORNER            120.01        0.00       70.00
NUMBER OF HORZ COLUMNS           81
NUMBER OF VERT COLUMNS           14
SCALE PER INCH OF PAGE        30.00
HORIZONTAL MESH                3.00
VERTICAL MESH                  5.00
```

F




```
TIME FOR CROSS SECTION ROUTINE      .121 SECONDS

LEAVE CROSS SECTION ROUTINE

END OF RUN
```

The printer plot (bordered by labeled B, C, D, and E) contains a printer character wherever the plane generated by the XSECT option intersects the selected regions of the COM-GEOM description of the Sample Target. The printer character printed denotes which item code hundred series the region display belongs. The item codes between 0 and 999 are denoted by the printer characters 0 through 9. The region identification codes between 1000 and 9999 are denoted by printer characters A through J. In the printout, printed character "1" denotes that the region displayed has an item code between 100 and 199 and "C" denotes that the region displayed has an item code between 3000 and 3999.

The second portion of the printer plot (labeled F) is the same plane as the first portion; however, the "DIRECTION COSINES OF RAYS" and the "DIRECTION DOSINES OF STARTING PTS" are interchanged. This is done to achieve a better plotter plot; the printer plot is just a by-product. Figure 86 is the line plot for the cross-section specified.

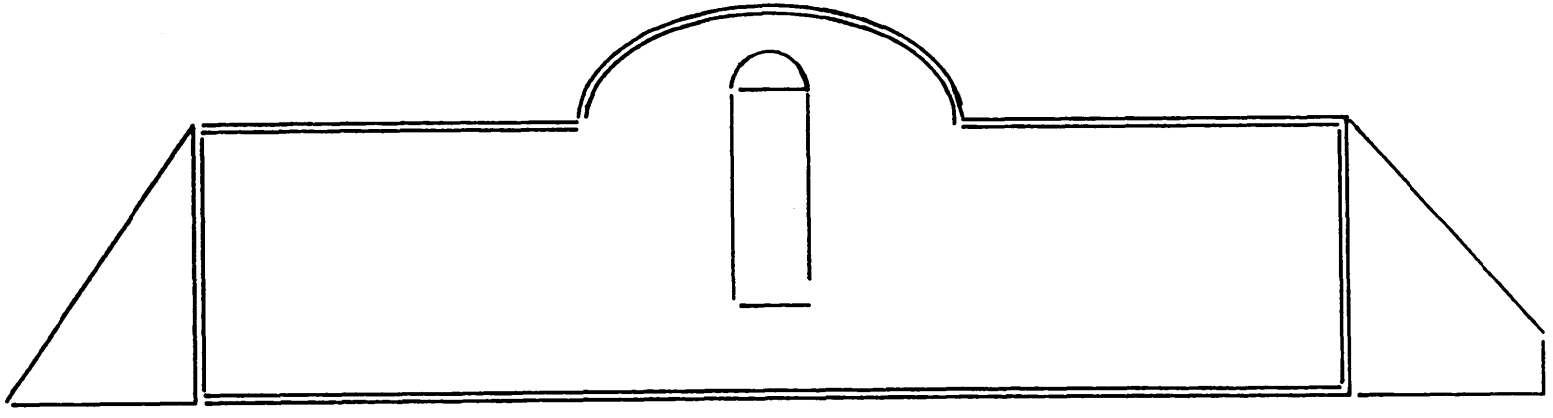


Figure 86. Sample Plot Generated by the XSECT Option

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